United States Government Accountability Office

GAO

Report to the Committee on Armed Services, U.S. Senate

September 2011

ORGANIZATIONAL TRANSFORMATION

Military Departments Can Improve Their Enterprise Architecture Programs

GAO-11-902

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GAO Accountability * Integrity * Reliability

Highlights

Highlights of GAO-11-902, a report to the Committee on Armed Services, U.S. Senate

Why GAO Did This Study

The Department of Defense (DOD) spends billions of dollars annually to build and maintain information technology (IT) systems intended to support its mission. For decades, DOD has been challenged in modernizing its systems environment to reduce duplication and increase integration. Such modernizations can be guided by an enterprise architecture—a blueprint that describes an organization's current and target state for its business operations and supporting IT systems and a plan for transitioning between the two states. DOD has long sought to employ enterprise architectures and has defined an approach for doing so that depends in large part on the military departments developing architectures of their own. In light of the critical role that military department enterprise architectures play in DOD's overall architecture approach, GAO was requested to assess the status of the Departments of the Air Force, Army, and Navy (DON) enterprise architecture programs. To do so, GAO obtained and analyzed key information about each department's architecture relative to the 59 core elements contained in stages 1 through 6 of GAO's Enterprise Architecture Management Maturity Framework.

What GAO Recommends

GAO recommends that the military departments each develop a plan for fully satisfying the elements of GAO's framework. DOD and Army concurred and the Air Force and DON did not. In this regard, DOD stated that Air Force and DON do not have a valid business case that would justify the implementation of all the elements. However, GAO continues to believe its recommendation is warranted.

View GAO-11-902 or key components. For more information, contact Valerie C. Melvin at (202) 512-6304 or melvinv@gao.gov.

What GAO Found

While Air Force, Army, and DON each have long-standing efforts to develop and use enterprise architectures, they have much to do before their efforts can be considered mature. GAO's enterprise architecture management framework provides a flexible benchmark against which to plan for and measure architecture program maturity and consists of 59 core elements arranged into a matrix of seven hierarchical stages. The Air Force has fully satisfied 20 percent, partially satisfied 47 percent, and not satisfied 32 percent of GAO's framework elements. The Army has fully satisfied 12 percent and partially satisfied 42 percent of the elements, with the remaining 46 percent not satisfied. Finally, DON has satisfied 27 percent, partially satisfied 41 percent, and not satisfied 32 percent of the framework elements (see table).

Military Department Satisfaction of GAO's Framework Core Elements (Percent)

Military department	Fully satisfied	Partially satisfied	Not satisfied
Air Force	20	47	32
Army	12	42	46
DON	27	41	32
Average	20	44	37

Source: GAO analysis of military department data.

Note: Numbers do not always add to 100 percent due to rounding.

With respect to stages 1 through 6 of GAO's architecture framework, the military departments have generally begun establishing institutional commitments to their respective enterprise architecture efforts (stage 1), not established the management foundations necessary for effective enterprise architecture development and use (stage 2), begun developing initial enterprise architecture content (stage 3), not completed and used their initial enterprise architecture versions to achieve results (stage 4), not expanded and evolved the development and use of their respective architectures to support institutional transformation (stage 5), and taken limited steps to continuously improve their respective architecture programs and use their architectures to achieve corporate optimization (stage 6).

Officials at the military departments stated that they have been limited in their ability to overcome long-standing enterprise architecture management challenges, including receiving adequate funding and attaining sufficient senior leadership understanding. Nevertheless, DOD has been provided with considerable resources for its IT systems environment, which consists of 2,324 systems. Specifically, DOD receives over $30 billion each year for this environment. Without fully developed and effectively managed enterprise architectures and a plan, the Air Force, Army, and DON lack the necessary road maps for transforming their business processes and modernizing their hundreds of supporting systems to minimize overlap and maximize interoperability. What this means is that DOD, as a whole, is not as well positioned as it should be to realize the significant benefits that a well-managed federation of architectures can afford its systems modernization efforts, such as eliminating system overlap and duplication. Because DOD is provided with over $30 billion each year for its IT systems environment, the potential for identifying and avoiding the costs associated with duplicative functionality across its IT investments is significant.

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Abbreviations

BEA	business enterprise architecture
CIO	chief information officer
DOD	Department of Defense
DON	Department of the Navy
EAMMF	Enterprise Architecture Management Maturity Framework
IGB	Information Enterprise Governance Board
IT	information technology
OMB	Office of Management and Budget

GAO
Accountability * Integrity * Reliability

United States Government Accountability Office
Washington, DC 20548

September 26, 2011

The Honorable Carl Levin
Chairman
The Honorable John McCain
Ranking Member
Committee on Armed Services
United States Senate

The Department of Defense (DOD) spends billions of dollars each year to maintain operational systems and processes intended to support its mission. In this regard, the department requested about $38 billion for its information technology (IT) investments for fiscal year 2012, including about $25 billion in combined investments at the Departments of the Air Force, Army, and Navy (DON).[1] According to DOD's systems inventory, the department's IT environment is composed of 2,324 systems and includes 338 financial management, 719 human resource management, 664 logistics, 250 real property and installation, and 300 weapon acquisition management systems.[2] Of the 2,324 systems, there are 470 systems at the Air Force, 744 at the Army, and 473 at DON. For decades, DOD has been challenged in modernizing its systems environment to reduce duplication and increase integration between its systems.

Effective use of a well-defined enterprise architecture[3] is a basic tenet of successful systems modernization and associated organizational transformation efforts, such as the one DOD has long been seeking to accomplish. As we have previously reported,[4] without a well-defined enterprise architecture, it is unlikely that DOD, including its component organizations, will be able to transform business processes and

[1]DON includes both the Navy and the Marine Corps.

[2]This data reflects the total number of systems (IT and National Security Systems) documented in DOD's Defense IT Portfolio Repository system as of March 1, 2011.

[3]An enterprise architecture is a modernization blueprint that describes the organization's current and desired state for its business operations and supporting IT systems in both logical and technical terms, and contains a plan for transitioning between the two states.

[4]GAO, *DOD Business Systems Modernization: Military Departments Need to Strengthen Management of Enterprise Architecture Programs*, GAO-08-519 (Washington, D.C.: May 2008).

modernize supporting systems to minimize overlap and maximize interoperability. Further, DOD's enterprise architecture approach relies on each level of its organization (e.g., DOD-wide, military departments, and programs) to develop a meaningful architecture. Accordingly, the development and use of a military department enterprise architecture is critical for organizational transformation and systems modernization across DOD and within each military department.

In light of the critical role that military department architectures play in DOD's enterprise architecture construct, you asked us to assess the status of the Departments of the Air Force, Army, and Navy's enterprise architecture programs. To accomplish this, we requested key information about each department's architecture governance, content, use, and measurement. On the basis of the military departments' responses and supporting documentation, we analyzed the extent to which each satisfied the 59 core elements in our architecture maturity framework.[5]

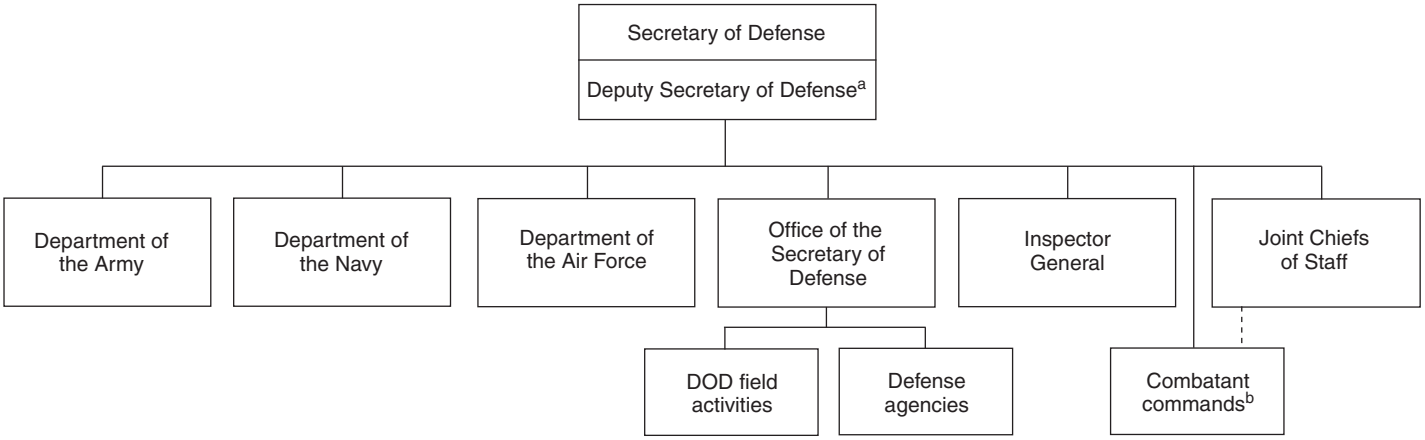
We conducted this performance audit at DOD and military department offices in the Washington, D.C., metropolitan area from October 2010 through September 2011 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objective. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objective. Details on our objective, scope, and methodology are provided in appendix I.

Background

DOD is a massive and complex organization entrusted with more taxpayer dollars than any other federal department or agency. Organizationally, the department includes the Office of the Secretary of Defense, the Joint Chiefs of Staff, the military departments, numerous defense agencies and field activities, and various unified combatant commands that are responsible for either specific geographic regions or specific functions. (See fig. 1 for a simplified depiction of DOD's organizational structure.)

[5]GAO, *Organizational Transformation: A Framework for Assessing and Improving Enterprise Architecture Management (Version 2.0),* GAO-10-846G (Washington, D.C.: August 2010).

Figure 1: Simplified View of DOD Organizational Structure



Source: GAO based on DOD documentation.

[a]The Deputy Secretary of Defense serves as the DOD Chief Management Officer, who has responsibilities, under statutes and department guidance, related to improving the efficiency and effectiveness of business operations.

[b]The Chairman of the Joint Chiefs of Staff serves as the spokesperson for the commanders of the combatant commands, particularly for the administrative requirements of the commands.

In support of its military operations, the department performs an assortment of interrelated and interdependent business functions, such as logistics management, weapons systems management, supply chain management, procurement, health care management, and financial management. For fiscal year 2012, the department requested about $38 billion for its IT investments, of which about $17 billion is intended for its business systems environment and supporting IT infrastructure, which includes systems and processes related to the management of contracts, finances, the supply chain, support infrastructure, and weapons systems acquisition. However, as we have previously reported,[6] the DOD systems environment that supports these business functions is overly complex and error prone, and is characterized by (1) little standardization across the department, (2) multiple systems performing the same tasks, (3) the same data being stored in multiple systems, and (4) the need for data to be entered manually into multiple systems.

[6]GAO, *Business Systems Modernization: DOD Continues to Improve Institutional Approach, but Further Steps Needed*, GAO-06-658 (Washington, D.C.: May 15, 2006).

DOD currently bears responsibility, in whole or in part, for 14 of the 30 federal government program areas that we have designated as high risk.[7] Seven of these areas are specific to DOD[8] and the department shares responsibility for 7 other governmentwide high-risk areas.[9] The lack of an effective enterprise architecture is a key contributor to its having many of these high-risk areas. DOD's business systems modernization, which is to be guided by the DOD Business Enterprise Architecture, is one of the high-risk areas, and is an essential component for addressing many of the department's other high-risk areas. For example, modernized business systems are integral to the department's efforts to address its financial, supply chain, and information security management high-risk areas. A well-defined and effectively implemented enterprise architecture is, in turn, integral to the successful modernization of DOD's business systems.

Enterprise Architecture Is Key to Transforming Business and Mission Operations

An enterprise architecture is a modernization blueprint that describes an organization's (e.g., a federal department or agency) or a functional area's (e.g., terrorism information sharing or homeland security) current and target state in both logical and technical terms, as well as a plan for transitioning between the two states. As such, it is a recognized tenet of organizational transformation and IT management in public and private organizations. Without an enterprise architecture, it is unlikely that an organization will be able to transform business processes and modernize supporting systems to minimize overlap and maximize interoperability. For more than a decade, we have conducted work to help federal agencies improve their architecture efforts. To this end, we developed the Enterprise Architecture Management Maturity Framework (EAMMF), which provides federal agencies with a common benchmarking tool for assessing the management of their enterprise architecture efforts and developing improvement plans.

[7]GAO, *High-Risk Series: An Update*, GAO-11-278 (Washington, D.C.: February 2011).

[8]These seven high-risk areas include DOD's overall approach to business transformation, business systems modernization, contract management, financial management, supply chain management, support infrastructure management, and weapon systems acquisition.

[9]The seven governmentwide high-risk areas include disability programs, protecting information systems and critical infrastructure, interagency contracting, information systems and critical infrastructure, information sharing for homeland security, human capital, and real property.

Enterprise Architecture Description and Importance

An enterprise can be viewed as either a single organization or a functional area that transcends more than one organization. An architecture can be viewed as the structure (or structural description) of any activity. Thus, enterprise architectures are systematically derived and captured descriptions depicted in models, diagrams, and narratives.

More specifically, an architecture describes the enterprise in logical terms (such as interrelated business processes and business rules, information needs and flows, and work locations and users) as well as in technical terms (such as hardware, software, data, communications, security attributes, and performance standards). It provides these perspectives both for the enterprise's current environment, and for its target environment, and it provides a transition plan for moving from the current to the target environment.

Enterprise architectures are a basic tenet of both organizational transformation and IT management, and their effective use is a recognized hallmark of successful public and private organizations. For over a decade, we have promoted the use of architectures, recognizing them as a crucial means to a challenging end: optimized agency operations and performance. The alternative, as our work has shown, is the perpetuation of the kinds of operational environments that saddle many agencies today, in which the lack of integration among business operations and the IT resources that support them leads to systems that are duplicative, not well integrated, and unnecessarily costly to maintain and interface.[10] Employed in concert with other important IT management controls (such as portfolio-based capital planning and investment control practices), an enterprise architecture can greatly increase the chances that an organization's operational and IT environments will be configured to optimize mission performance. Moreover, the development of agency

[10]GAO, *Federal Aviation Administration: Stronger Architecture Program Needed to Guide Systems Modernization Efforts,* GAO-05-266 (Washington, D.C.: Apr. 29, 2005); *Homeland Security*: *Efforts Under Way to Develop Enterprise Architecture, but Much Work Remains*, GAO-04-777 (Washington, D.C.: Aug. 6, 2004); GAO-04-731R; *Information Technology*: *Architecture Needed to Guide NASA's Financial Management Modernization,* GAO-04-43 (Washington, D.C.: Nov. 21, 2003); GAO-03-1018; *Business Systems Modernization: Summary of GAO's Assessment of the Department of Defense's Initial Business Enterprise Architecture*, GAO-03-877R (Washington,, D.C.; July 7, 2003); *Information Technology*: *DLA Should Strengthen Business Systems Modernization Architecture and Investment Activities*, GAO-01-631 (Washington, D.C.: June 29, 2001); and *Information Technology: INS Needs to Better Manage the Development of Its Enterprise Architecture*, GAO/AIMD-00-212 (Washington, D.C.: Aug. 1, 2000).

enterprise architectures is based on statutory requirements and federal guidance.[11] Further, DOD is required by statute[12] to develop an enterprise architecture to cover all defense business systems, and the business transformation initiatives of the military departments are required to develop a well-defined enterprisewide business systems architecture.[13]

Enterprise Architecture Approaches

There are several approaches to structuring an enterprise architecture, depending on the needs of the agency. In general, these approaches provide for decomposing an enterprise into its logical parts and architecting each of the parts in relation to enterprisewide needs and the inherent relationships and dependencies that exist among the parts. As such, the approaches are fundamentally aligned and consistent with a number of basic enterprise architecture principles, such as incremental rather than monolithic architecture development and implementation, optimization of the whole rather than optimization of the component parts, and maximization of shared data and services across the component parts rather than duplication. Moreover, these approaches are not mutually exclusive and, in fact, can all be applied to some degree for a given enterprise, depending on the characteristics and circumstances of that enterprise. The approaches, which are briefly described here, are federated, segmented, and service-oriented.

Federated

Under a federated approach, the architecture consists of a family of coherent but distinct member architectures that conform to an overarching corporate (i.e., enterprise-level) or parent architecture. This approach recognizes that each federation member has unique goals and needs as well as common roles and responsibilities with the members above and below it. As such, member architectures (e.g., component, subordinate, or subsidiary architectures) are substantially autonomous,

[11]Clinger-Cohen Act, 40 U.S.C. § 11315(b)(2); E-Government Act, 44 U.S.C. § 3602(f)(14); Chief Information Officers Council, *A Practical Guide to Federal Enterprise Architecture*, Version 1.0 (February 2001); OMB, *Information Technology Architectures*, Memorandum M-97-16 (June 18, 1997), rescinded with the update of OMB Circular A-130 (Nov. 30, 2000); *Improving Agency Performance Using Information and Information Technology (Enterprise Architecture Assessment Framework v3.1)* (June 2009).

[12]10 U.S.C. § 2222(c)(1).

[13]Duncan Hunter National Defense Authorization Act for Fiscal Year 2009, Pub. L. No. 110-417, § 908(b)(2).

but they also inherit certain rules, policies, procedures, and services from the parent architectures. A federated architecture enables component organization autonomy while ensuring enterprise-level or enterprisewide linkages and alignment where appropriate.

Segmented

A segmented approach to enterprise architecture development and use, like a federated approach, employs a “divide and conquer” methodology in which architecture segments are identified, prioritized, developed, and implemented. In general, segments can be viewed as logical aspects, or “slivers,” of the enterprise that can be architected and pursued as separate initiatives under the overall enterprise-level architecture. As such, the segments serve as a bridge between the corporate frame of reference captured in the enterprise architecture and individual programs within portfolios of system investments.

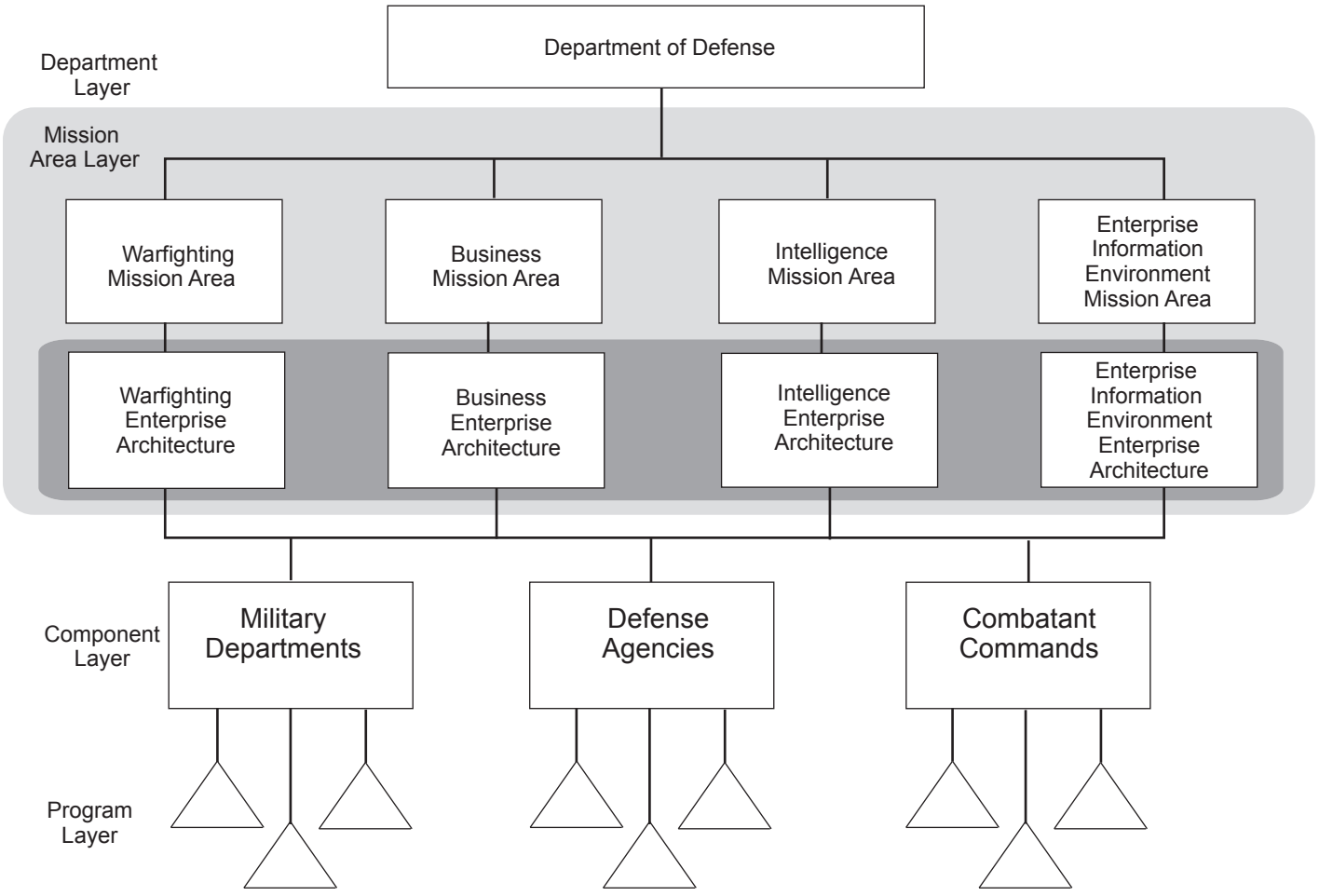
Service-Oriented

Under this approach, functions and applications are defined and designed as discrete and reusable capabilities or services that may be under the control of different organizational entities. As such, the capabilities or services need to be, among other things, (1) self-contained, meaning that they do not depend on any other functions or applications to execute a discrete unit of work; (2) published and exposed as self-describing business capabilities that can be accessed and used; and (3) subscribed to via well-defined and standardized interfaces. This approach is intended to reduce redundancy and increase integration, as well as provide the flexibility needed to support a quicker response to changing and evolving business requirements and emerging conditions.

DOD Has Adopted a Federated Approach to Its Enterprise Architecture

DOD has adopted a federated strategy to develop and implement the many and varied architectures across the department. This strategy is to provide a comprehensive architectural description of the entire DOD enterprise, including the relationships between and among all levels of the enterprise (e.g., enterprise-level, mission areas, components, and programs). Figure 2 shows a simplified conceptual depiction of DOD's federated enterprise architecture.

Figure 2: Conceptual Representation of DOD's Federated Architecture



Source: GAO analysis of DOD data.

DOD's Enterprise Architecture Federation Strategy describes specific roles and responsibilities for each level of its federated architecture.

These roles and responsibilities are consistent with DOD's tiered accountability approach to systems modernization, whereby components (e.g., mission areas, military departments, etc.) are responsible for defining their respective component architectures and transition plans and program managers are responsible for developing program-level architectures and transition plans and ensuring integration with the architectures and transition plans developed and executed at the component and enterprise levels. For example, each level of the federation is responsible for developing its respective architecture and imposing constraints on the levels below. Accordingly, the completeness of the DOD federated enterprise architecture depends on each level of the federation developing its own respective enterprise architecture. Moreover, since the military departments comprise such a large portion of the DOD enterprise, the relative importance of their respective enterprise architectures is significant.

GAO's Enterprise Architecture Management Maturity Framework

In 2002, we developed version 1.0[14] of the EAMMF to provide federal agencies with a common benchmarking tool for planning and measuring their efforts to improve management of their enterprise architectures, as well as to provide OMB with a means for doing the same governmentwide. We issued an update to the framework (version 1.1) in 2003[15] and a new version (version 2.0) in 2010.[16] Version 2.0 expands on prior versions based on our experience in using them in evaluating governmentwide and agency-specific enterprise architectures and our solicitation of comments from federal agencies and other stakeholders on the usability, completeness, and sufficiency of the framework. The latest version provides a more current and pragmatic construct for viewing architecture development and use. In this regard, it provides a flexible benchmark against which to plan for and measure architecture program management maturity that permits thoughtful and reasonable discretion to be applied in using it. Restated, the framework is not intended to be a rigidly applied "one size fits all" checklist, but rather a flexible frame of reference that should be applied in a manner that makes sense for each

[14]GAO, *Information Technology: Enterprise Architecture Use across the Federal Government Can Be Improved*, GAO-02-6 (Washington, D.C.: Feb. 19, 2002).

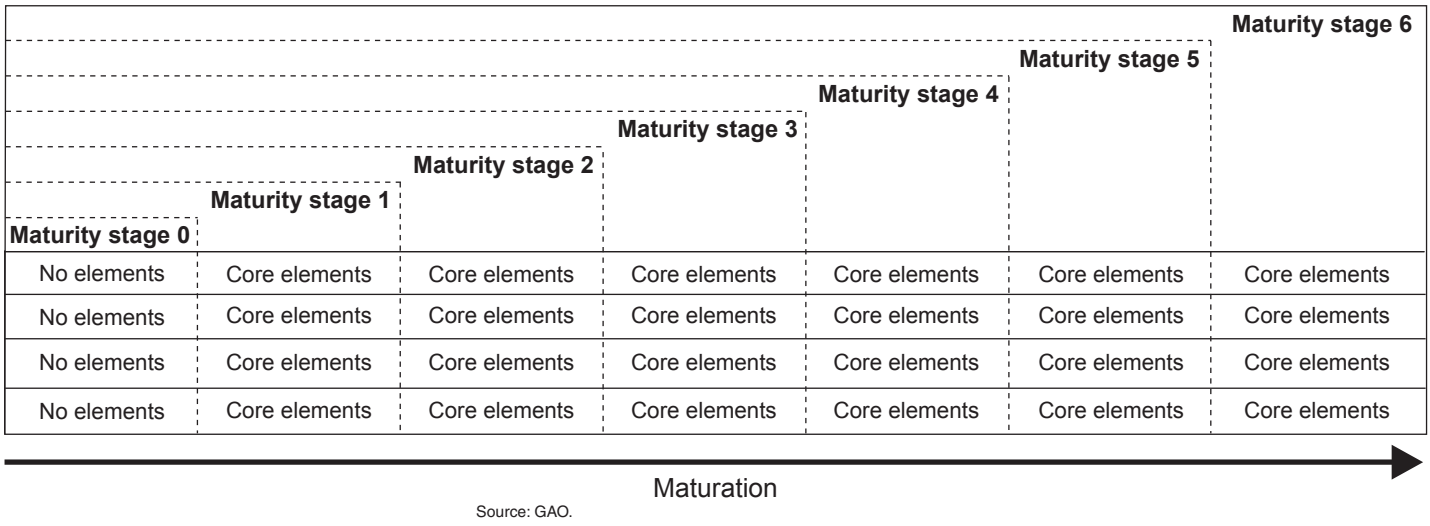
[15]GAO, *Information Technology: A Framework for Assessing and Improving Enterprise Architecture Management* (version 1.1), GAO-03-584G (Washington, D.C.: April 2003).

[16]GAO-10-846G.

organization's unique facts and circumstances. Specifically, depending on the size, scope, and complexity of the enterprise, not every framework core element may be equally applicable, not every assessment has to consider every element, and not every assessment has to consider every element in the same level of detail. Moreover, the framework is not intended to be viewed as the sole benchmarking tool for informing and understanding an organization's journey toward architecture maturity.

Version 2.0 of the framework arranges 59 core elements into a matrix of seven hierarchical stages. Figure 3 presents a depiction of the seven stages of maturity.

Figure 3: EAMMF Overview with Seven Stages of Maturity



Source: GAO.

EAMMF Stages

Each maturity stage includes all the core elements that are resident in the previous stages. Each stage is described in detail here. Appendix II provides a list of core elements arranged by their respective EAMMF stages.

Stage 0: Creating Enterprise Architecture Awareness

At this stage, either an organization does not have plans to develop and use an enterprise architecture or it has plans that do not demonstrate an awareness of the management discipline needed to successfully develop, maintain, and use an enterprise architecture. While Stage 0 organizations

may have initiated some enterprise architecture activity, their efforts are largely ad hoc and unstructured and lack the institutional leadership necessary for successful development, maintenance, and use as defined in Stage 1. Therefore, Stage 0 has no associated core elements.

Stage 1: Establishing Enterprise Architecture Institutional Commitment and Direction

At this stage, an organization puts in place the foundational pillars for treating its enterprise architecture program as an institution and for overcoming traditional barriers to its success. For example, the organization grounds enterprise architecture development and compliance in policy and recognizes it as a corporate asset by vesting ownership of the architecture with top executives (i.e., lines of business owners and chief "X" officers).[17] As members of a chartered architecture executive committee, these individuals are provided with the knowledge and understanding of the architecture concepts and governance principles needed to lead and direct the enterprise architecture effort. Through the enterprise architecture executive committee (hereafter referred to as the Executive Committee), leadership is demonstrated through the approval of enterprise architecture goals and objectives and key aspects of the architecture's construct, such as the framework(s) to be used and the approach for establishing the hierarchy and structure of organization components (e.g., federation members, segments, etc.). Also during this stage, the central figure in managing the program, the Chief Architect, is appointed and empowered, and the integral and relative role of the enterprise architecture vis-à-vis other enterprise-level governance disciplines is recognized in enterprise-level policy. Organizations that achieve this maturity stage have demonstrated enterprise architecture leadership through an institutional commitment to developing and using the enterprise architecture as a strategic basis for directing its development, maintenance, and use.

[17]Chief "X" officer is a generic term for job titles where "X" represents a specific specialized position that serves the entire organization, such as the chief information officer, chief financial officer, chief human capital officer, chief procurement officer, chief performance officer, chief technology officer, chief information security officer, or chief management officer.

Stage 2: Creating the Management Foundation for Enterprise Architecture Development and Use

This stage builds on the strategic leadership foundation established in Stage 1 by creating the managerial means to the ends—an initial version of the enterprise architecture (Stages 3 and 4) and an evolving and continuously improving enterprise architecture (Stages 5 and 6) that can be used to help guide and direct investments and achieve the architecture's stated purpose. For example, at this stage the organization establishes operational enterprise architecture program offices, including an enterprise-level program office that is headed by the Chief Architect, who reports to the Executive Committee. Also at this stage, the Executive Committee continues to exercise leadership by ensuring that the Chief Architect and subordinate architects have the funding and human capital needed to "stand up" their respective program offices and have acquired the requisite architecture tools (development and maintenance methodologies, modeling tools, and repository). Organizations that achieve this stage have largely established the program management capacity needed to develop an initial version of the enterprise architecture.

Stage 3: Developing Initial Enterprise Architecture Versions

At this stage, an organization is focused on strengthening the ability of its program office(s) to develop an initial version of the enterprise architecture while also actually developing one or more of these versions. Among other things, steps are taken to engage stakeholders in the process and implement human capital plans, to include hiring and training staff and acquiring contractor expertise. During this stage, these resources are combined with earlier acquired tools (e.g., framework(s), methodologies, modeling tools, and repositories) to execute enterprise architecture management plans and schedules aimed at delivering an initial enterprise-level version of the architecture that includes current and target views of the performance, business, data, services, technology, and security architectures, as well as an initial version of a plan for transitioning from the current to the target views. Also during this stage, one or more segment architectures or federation member architectures are being developed using available tools and defined plans and schedules, and progress in developing initial architecture versions is measured by the Chief Architect and reported to the Executive Committee. Although an organization at this maturity stage does not yet have a version of an enterprise architecture that is ready for implementation, it is well on its way to defining an enterprise architecture

of sufficient scope and content that can be used to guide and constrain investments in a way that can produce targeted results.

Stage 4: Completing and Using an Initial Enterprise Architecture Version for Targeted Results

At this stage, an organization has developed a version of its enterprise-level architecture that has been approved by the Executive Committee, to include current and target views of the performance, business, data, services, technology, and security architectures, as well as an initial version of a plan for transitioning from the current to the target views. In addition, one or more segment and/or federation member architectures have been developed and approved according to established priorities. Moreover, the approved enterprise-level and subordinate architectures are being used to guide and constrain capital investment selection and control decisions and system life-cycle definition and design decisions. Also during this stage, a range of factors are measured and reported to the Executive Committee, such as enterprise architecture product quality, investment compliance, subordinate architecture alignment, and results and outcomes. Organizations that achieve this stage of maturity have a foundational set of enterprise-level and subordinate enterprise architecture products that provide a meaningful basis for informing selected investments and building greater enterprise architecture scope, content, use, and results.

Stage 5: Expanding and Evolving the Enterprise Architecture and Its Use for Institutional Transformation

At this stage, the enterprise architecture's scope is extended to the entire organization, and it is supported by a full complement of segment and federation member architectures, all of which include current and target views of the performance, business, data, services, technology, and security architectures, as well as well-defined plans for transitioning from the current to the target views. Moreover, this suite of architecture products is governed by a common enterprise architecture framework, methodology, and repository, thus permitting the products to be appropriately integrated. Also at this stage, the architecture products are continuously maintained, and major updates of the enterprise-level architecture are approved by the head of the organization, while subordinate architecture product updates are approved by their corresponding organization heads or segment owners. In addition, architecture product quality (i.e., completeness, consistency, usability, and utility) as well as enterprise architecture management process

integrity are assessed by an independent agent, and the results are reported to the Chief Architect and the Executive Committee. An organization that achieves this level of maturity has established a full suite of architecture products that can be employed as a featured decision support tool when considering and planning large-scale organizational restructuring or transformation initiatives.

Stage 6: Continuously Improving the Enterprise Architecture and Its Use to Achieve Corporate Optimization

At this stage, an organization is focused on continuously improving the quality of its suite of enterprise architecture products and the people, processes, and tools used to govern their development, maintenance, and use. By achieving this stage of maturity, the organization has established a truly enterprisewide blueprint to inform both "board room" strategic planning and decision making and "on-the-ground" implementation of these changes through a range of capital investment and maintenance projects and other enterprise-level initiatives.

Prior Reviews of Federal Department and Agency Enterprise Architectures

In 2002 and 2003, we reported on the status of enterprise architectures governmentwide, including for the Departments of the Air Force, Army, and Navy.[18] We found that some federal agencies had begun to establish the management foundation needed to successfully develop, implement, and maintain an enterprise architecture, but that executive leadership was key to addressing management challenges identified by enterprise architecture programs: (1) overcoming limited executive understanding, (2) inadequate funding, (3) insufficient number of skilled staff, and (4) organizational parochialism. Accordingly, we made recommendations to OMB to improve enterprise architecture leadership and oversight.[19] OMB responded to these recommendations by establishing its Chief Architects Forum to, among other things, share enterprise architecture best practices among federal agencies and by developing an enterprise architecture assessment tool, which it used to periodically evaluate enterprise architecture programs at federal agencies.

[18]GAO-02-6; GAO, *Information Technology: Leadership Remains Key to Agencies Making Progress on Enterprise Architecture Efforts*, GAO-04-40 (Washington, D.C.: Nov. 17, 2003).

[19]The E-Government Act of 2002 assigns OMB responsibility for overseeing the development of enterprise architectures within and across agencies.

In 2006, we reviewed[20] enterprise architecture management at 27 federal agencies and found that management improvements were needed. Overall, most agencies had not reached a sufficient level of maturity in their enterprise architecture development, particularly with regard to their approaches to assessing each investment's alignment with the enterprise architecture and measuring and reporting on enterprise architecture results and outcomes. In addition, the military departments comprised three of the four agencies with the lowest overall satisfaction of key enterprise architecture management practices.

Our 2006 report also identified that challenges facing agencies across the federal government in developing and using enterprise architectures are formidable. Specifically, 93 percent of federal departments and agencies reported that they had encountered organizational parochialism and cultural resistance to enterprise architecture to a significant (very great or great) or moderate extent. Other challenges reported were ensuring that the architecture program had adequate funding (89 percent), obtaining staff skilled in the architecture discipline (86 percent), and having department or agency senior leaders that understand the importance and role of the enterprise architecture (82 percent). We identified leadership as a key to overcoming these management challenges and made specific recommendations to individual agencies to address their challenges and manage their programs. Since 2006, we have continued to report that sustained top management leadership is the key to overcoming these challenges and positioning agencies to achieve enterprise architecture-related benefits such as improved alignment between their business operations and the IT that supports these operations and consolidation of their IT infrastructure environments.

Between 2005 and 2008, we reported that DOD had taken steps to comply with key requirements of the National Defense Authorization Act for Fiscal Year 2005[21] relative to architecture development;[22] however,

[20]GAO, *Enterprise Architecture: Leadership Remains Key to Establishing and Leveraging Architectures for Organizational Transformation*, GAO-06-831 (Washington, D.C.: Aug. 14, 2006).

[21]Pub. L. No. 108-375, § 332, 118 Stat. 1811, 1851-1856 (Oct. 28, 2004) (codified in part at 10 U.S.C. § 2222).

each report also concluded that much remained to be accomplished relative to the act's requirements and relevant guidance.[23] We further reported in May 2008[24] that the military departments' enterprise architecture programs had yet to advance to a level that could be considered fully mature. Specifically, we reported that all three departments were at the initial stage of maturity as defined in version 1.1 of GAO's architecture maturity framework and had yet to fulfill the framework's requirements for, among other things, establishing a management foundation for developing, maintaining, and using the architecture. We reported that DOD, as a whole, was not as well positioned as it should be to realize the significant benefits that a well-managed federation of architectures can afford its business systems modernization efforts.

More recently, we reported[25] on the need for federal agencies to measure and report enterprise architecture results and outcomes as key mechanisms for identifying overlap and duplication. Specifically, we stated that while some progress has been made in improving management, more time is needed for agencies to fully realize the value of having well-defined and implemented architectures. Such value can be derived from realizing cost savings through consolidation and reuse of shared services and elimination of antiquated and redundant mission operations, enhancing information sharing through data standardization and system integration, and optimizing service delivery through

[22]The act required DOD to, among other things, develop an enterprise architecture to cover all defense business systems and their related functions and activities. The act further required that the Secretary of Defense submit an annual report to congressional defense committees on DOD's compliance with certain requirements of the act not later than March 15 of each year. Additionally, the act directed us to submit to these congressional committees—within 60 days of DOD's report submission—an assessment of the department's actions to comply with these requirements.

[23]GAO, *DOD Business Systems Modernization: Progress in Establishing Corporate Management Controls Needs to Be Replicated Within Military Departments*, GAO-08-705 (Washington, D.C.: May 15, 2008); *DOD Business Systems Modernization: Progress Continues to Be Made in Establishing Corporate Management Controls, but Further Steps Are Needed,* GAO-07-733 (Washington, D.C.: May 14, 2007); GAO-06-658; and *DOD Business Systems Modernization: Important Progress Made in Establishing Foundational Architecture Products and Investment Management Practices, but Much Work Remains*, GAO-06-219 (Washington, D.C.: Nov. 23, 2005).

[24]GAO-08-519.

[25]GAO, *Opportunities to Reduce Potential Duplication in Government Programs, Save Tax Dollars, and Enhance Revenue*, GAO-11-318SP (Washington, D.C.: Mar. 1, 2011).

streamlining and normalization of business processes and mission operations.

Military Departments Have Begun to Develop Enterprise Architectures, but Management and Use Can Be Improved

The Air Force, Army, and DON each have long-standing efforts in place to develop and use an enterprise architecture, but much remains to be accomplished before these efforts can be considered sufficiently mature to fully support ongoing organizational transformation and corporate optimization efforts. Specifically, the Air Force has fully satisfied 20 percent, partially satisfied 47 percent, and not satisfied 32 percent of GAO's enterprise architecture framework elements.[26] The Army has fully satisfied 12 percent and partially satisfied 42 percent of elements, with the remaining 46 percent not satisfied. Finally, DON has satisfied 27 percent, partially satisfied 41 percent, and not satisfied 32 percent of framework elements. (Table 1 summarizes each military department's satisfaction of core enterprise architecture management elements and detailed results are presented in appendices III, IV, and V.)

Table 1: Military Department Satisfaction of Core Enterprise Architecture Management Elements

Military department	Fully satisfied	Partially satisfied	Not satisfied
Air Force	20	47	32
Army	12	42	46
DON	27	41	32
Average	20	44	37

Source: GAO analysis of military department data.

Note: Numbers do not always add to 100 percent due to rounding.

More specifically, while the military departments have each demonstrated that they are beginning to establish an institutional commitment to their respective enterprise architecture by addressing many of the elements described in Stage 1 of GAO's enterprise architecture management framework and to develop initial enterprise architecture content (Stage 3), they have generally not established a well-developed enterprise architecture management foundation (Stage 2). Moreover, the

[26]Due to the large and complex nature of the DOD enterprise, we determined that all 59 elements of the framework apply to the military department enterprise architecture programs.

departments have yet to complete and use their initial enterprise architecture versions to achieve targeted results (Stage 4) or expand and evolve their respective architectures to support institutional transformation (Stage 5). Finally, the departments have taken limited steps to continuously improve their respective architecture programs and use their architectures to achieve enterprisewide optimization (Stage 6). Officials at the military departments stated that they continue to face long-standing enterprise architecture management challenges, such as receiving adequate funding, overcoming cultural resistance and attaining sufficient senior leadership understanding. Nevertheless, DOD has been provided with considerable resources for its IT systems environment. Specifically, in recent years, DOD has been provided with over $30 billion annually for this environment. In addition, for fiscal year 2012, DOD has requested about $38 billion for its IT investments.

Without fully developed and effectively managed enterprise architectures, the Air Force, Army, and DON do not have a sufficient architectural basis for transforming their business processes and modernizing their thousands of supporting systems to minimize overlap and maximize interoperability. Consequently, DOD as a whole is not well positioned to realize the significant benefits that a well-managed set of architectures can contribute to its ongoing operational and IT system modernization efforts, such as eliminating system overlap and duplication. Because DOD is provided with over $30 billion each year for its IT systems environment, the potential for identifying and avoiding the costs associated with duplicative functionality across its IT investments is significant.

Military Departments Have Each Begun to Establish an Institutional Commitment to an Enterprise Architecture

Stage 1 of GAO's EAMMF describes elements associated with establishing the foundational pillars for treating the enterprise architecture as an institution and for overcoming barriers to success. Examples of these elements include establishing an enterprise architecture policy and an executive committee and defining the roles and responsibilities of key players and associated metrics to help ensure that their respective roles and responsibilities are fulfilled.

The military departments have demonstrated that they are beginning to establish an institutional commitment to their respective enterprise architecture by fully satisfying 42 percent, partially satisfying 42 percent, and not satisfying 17 percent of the Stage 1 elements. Table 2 describes the extent to which each military department has satisfied the Stage 1 elements.

Table 2: Military Department Satisfaction of Stage 1 Framework Elements

Military department	Fully satisfied	Partially satisfied	Not satisfied
Air Force	50	38	13
Army	25	50	25
DON	50	38	13
Average	42	42	17

Source: GAO analysis of military department data.

Note: Numbers do not always add to 100 percent due to rounding.

The following examples describe the military departments' performance relative to selected Stage 1 elements.

Policy: All three of the military departments have fully satisfied the element associated with establishing a policy for enterprise architecture development, maintenance, and use. Establishing such a policy is important for, among other things, confirming an organization's institutional commitment to an enterprise architecture and defining the entities responsible for architecture development, maintenance, and use.

Executive committee: Air Force and DON have fully satisfied, and Army has partially satisfied the element that is associated with establishing an executive committee representing the enterprise and that is responsible and accountable for the architecture. Although the Army has established committees responsible for some segment architecture activities, it has not yet established an executive committee responsible for an enterprise-level architecture. Establishing enterprisewide responsibility and accountability is important for demonstrating the organization's institutional commitment to enterprise architecture and for obtaining buy-in from across the organization. Such an executive committee also helps the enterprise architecture effort address issues that might not be entirely within the span of control of the organizational Chief Architect, such as obtaining adequate funding and sufficient human capital resources.

Performance and accountability framework: None of the military departments has fully or partially satisfied the element associated with establishing an enterprise architecture performance and accountability framework that recognizes the critical roles and responsibilities of key stakeholders and provides the metrics and means for ensuring that roles and responsibilities are fulfilled. Specifically, none of the military departments has defined the metrics and means for ensuring that roles and responsibilities are fulfilled. Successfully managing any program,

including an enterprise architecture program, depends in part on establishing clear commitments and putting in place the means by which to determine progress against these commitments and hold responsible parties accountable for the results.

To their credit, each of the military departments has taken important steps to address the Stage 1 core elements, and, as a result, has begun to establish key institutional commitments to developing and using an enterprise architecture. Establishing such institutional commitments is the first step to overcoming long-standing barriers to enterprise architecture success, such as top leadership understanding and parochialism and cultural resistance. Without such commitments, these barriers may continue to limit the ability of an architecture program to contribute to efforts to improve the organization, which may range from streamlining business processes and IT that supports a specific organizational line of business (e.g., a segment) to larger and more significant organizationwide improvement efforts.

Military Departments Lack Well-Developed Management Foundations for Enterprise Architecture Development and Use

Stage 2 of GAO's EAMMF describes elements that build on the strategic leadership commitment established in Stage 1 by creating the managerial means to accomplish activities in later stages, including developing an initial version of the enterprise architecture (Stages 3 and 4) and evolving and continuously improving an enterprise architecture (Stages 5 and 6) that can be used to help guide and direct investments and achieve the architecture's stated purpose. Examples of these elements include selecting automated tools, establishing an enterprise architecture program management office, developing a program management plan, justifying and funding program resources, and defining human capital plans.

The military departments' satisfaction of these Stage 2 core elements demonstrates that much remains to be accomplished to establish their respective enterprise architecture management foundations. Specifically, the military departments have collectively satisfied only 17 percent, partially satisfied 47 percent, and not satisfied 37 percent of these elements. Table 3 describes the extent to which each military department has satisfied Stage 2 framework elements.

Table 3: Military Department Satisfaction of Stage 2 Framework Elements

Military department	Fully satisfied	Partially satisfied	Not satisfied
Air Force	10	50	40
Army	20	40	40
DON	20	50	30
Average	17	47	37

Source: GAO analysis of military department data.

Note: Numbers do not always add to 100 percent due to rounding.

The following examples describe the military departments' performance relative to selected Stage 2 elements.

Automated tools: The Air Force, Army, and DON have each fully satisfied the element associated with selecting automated enterprise architecture tools. Automated tools support the creation of a holistic view of the current and target state of the enterprise by assisting in the process of extracting, assimilating, relating, and presenting critical organizational information (e.g., the relationships between business operations and associated performance metrics, information exchanges, supporting applications and services, technology standards, and security protocols).

Program office: All three of the military departments have partially satisfied the element associated with establishing an enterprise architecture program office. Although both Air Force and DON have established a small team dedicated to enterprise architecture development and use, they do not operate within a formally chartered program office. In addition, while Army has established chartered program management offices for its three primary segments, it has not established an enterprise-level architecture program management office. Air Force officials stated that the department does not manage its enterprise architecture as a formal program, DON officials stated that the department is unable to justify creating a large program office in a fiscally constrained environment, and Army officials recognized the need to establish an enterprise-level architecture program management office in the future. We and the federal Chief Information Officers Council have previously reported that enterprise architecture development and

maintenance should be managed as a formal program.[27] Doing so helps ensure that the enterprise architecture program receives the appropriate attention and sufficient funding and human capital resources needed to be successful. In addition, establishing such an office would provide accountability for achieving its desired results. Accordingly, the program office should be responsible to the Executive Committee for ensuring that critical activities that are within its span of authority and control, such as enterprise architecture program planning and performance monitoring, enterprise architecture development and maintenance using supporting tools, and enterprise architecture configuration management, are performed.

Program management plan: None of the three military departments has fully satisfied the element associated with managing its enterprise architecture activities according to an enterprise architecture program management plan. To their credit, Army and DON have partially satisfied the element. For example, DON has established a governance plan that defines enterprise architecture management structures and stakeholder roles and responsibilities and Army has established a program management plan for its Network segment,[28] which addresses at least some enterprisewide requirements. However, Army and DON have yet to develop comprehensive plans for managing their architecture programs. In addition, although Air Force officials stated that the department produces an annual roadmap from which goals and schedules are developed, Air Force officials did not provide evidence to demonstrate that a program management plan exists that includes information such as management controls and accountability mechanisms. DON officials stated that they are in the process of developing a road map that will serve as a program management plan and Army officials stated that the department plans to establish a program management office that addresses key program management activities. An enterprise architecture program management plan would provide the range of management structures, controls, disciplines, roles, and accountability mechanisms discussed throughout the framework as well as descriptions of the major

[27]See, for example, GAO-10-846G, GAO-06-831, GAO-04-40, GAO-03-584G, GAO-02-6; Chief Information Officers Council, *A Practical Guide to Federal Enterprise Architecture*, Version 1.0 (February 2001).

[28]According to Army officials, the Network segment defines technologies, information sharing, and transport capabilities.

enterprise architecture releases or increments to be developed. In this regard, the plan is a critical tool for providing a bridge between more conceptual frameworks and methodologies to the detailed and actionable work breakdown structures and schedules. As such, it is important for the departments to develop such a plan to ensure that the enterprise architecture program is effectively managed.

Budgetary needs: Each of the military departments has partially satisfied the element associated with justifying and funding enterprise architecture budgetary needs. All of the military departments agree that sufficient resources to establish and execute their respective enterprise architecture programs are not available but that the level of current funding has enabled them to continue executing certain architectural activities. Nevertheless, DOD has been provided with considerable resources for its IT systems environment. Specifically, in recent years, DOD has been provided with over $30 billion annually for this environment. In addition, for fiscal year 2012, DOD has requested about $38 billion for its IT investments. Moreover, architecture budgetary needs have not been identified and justified through reliable cost estimating and expected program benefits. By funding enterprise architecture as a capital investment, an organization's leadership demonstrates its long-term commitment to having and using an enterprise architecture to inform investment decision making and optimize mission-facing and mission-supporting operations. Such funding requests also establish expected enterprise architecture program benefits that, in turn, provide justification for department and agency enterprise architecture expenditures and establish commitments against which enterprise architecture program managers and department executives can be held accountable.

Human capital plans: None of the three departments has fully or partially satisfied the element associated with developing human capital plans that identify the knowledge, skills, and abilities needed for enterprise architecture staff. Army officials recognized the need for such a plan and stated that the department's updated enterprise architecture regulation will include a requirement for such a human capital plan. DON officials stated that a human capital plan is not necessary due to their small number of staff and lack of a large centralized program office. Air Force officials stated that the department does not plan to develop such a plan because enterprise architecture is not a formally established career field within the federal government. However, having sufficient human capital to successfully develop and maintain the enterprise architecture begins with identifying human capital needs and developing a plan for acquiring, developing, and retaining qualified staff with the requisite

knowledge, skills, and abilities. The enterprise architecture human capital plan is the vehicle for addressing enterprise architecture program skill gaps by, for example, training existing staff, hiring new staff, using contractor staff, and addressing staff retention, development, and recognition and reward.

Agencies that achieve this stage have largely established the program management capability needed to develop an initial architecture version. By not satisfying the majority of the elements at this stage, which as stated creates the managerial means to the ends, the military departments risk not being able to effectively execute higher stage core elements. For example, an agency can begin developing initial architecture products that describe its current and target environment, and a plan for transitioning from its current to its target environment (Stage 3); however, without establishing enterprise architecture management plans to guide its enterprise architecture efforts (Stage 2), it risks not delivering an architecture that can be used for achieving target results and institutional transformation (Stages 4 and 5).

Military Departments Have Begun to Develop Initial Enterprise Architecture Content

Stage 3 of our EAMMF describes elements associated with strengthening the ability of a program office to develop initial versions of the enterprise architecture by leveraging acquired resources and tools (established in Stages 1 and 2) to execute enterprise architecture management plans and schedules. Examples of these elements include developing subordinate architectures, developing initial enterprise-level architecture versions, and using the selected enterprise architecture methodology.

The military departments' satisfaction of these Stage 3 core elements demonstrates that they have begun to develop initial enterprise architecture content. Specifically, the military departments have satisfied 26 percent, partially satisfied 45 percent, and not satisfied 29 percent of these elements. Table 4 describes the extent to which each department has satisfied Stage 3 framework elements.

Table 4: Military Department Satisfaction of Stage 3 Framework Elements

Military department	Fully satisfied	Partially satisfied	Not satisfied
Air Force	29	50	21
Army	14	50	37
DON	36	36	29
Average	26	45	29

Source: GAO analysis of military department data.

Note: Numbers do not always add to 100 percent due to rounding.

The following examples describe the military departments' performance relative to selected Stage 3 elements.

Subordinate architectures: All of the military departments have satisfied the element associated with developing one or more segment and/or federation architecture. For example, the Air Force approved version 1.0 of its Space Domain architecture in September 2010; the Army is developing architectures for its Generating Force and Network segments; and DON has developed architecture artifacts for its Net Centric segment.[29] As we have previously reported,[30] successful enterprise architecture development for large, complex federal agencies does not involve an "all-or-nothing" monolithic approach. Rather, enterprise architecture development typically follows a "divide and conquer" strategy in which the level of architectural detail needed to guide and constrain individual investments is created for distinct organizational components or functional slices of the enterprise. In taking such an approach, the level of architectural content that needs to be defined to sufficiently inform high-priority, near-term system investments can be established relatively quickly, thus allowing the benefits of the enterprise architecture to be realized sooner rather than later.

[29]The Space Domain is to address operational capabilities and systems that enable space related system functions and the interaction of those systems with corresponding air and ground systems. According to Army officials, the Network segment defines technologies, information sharing, and transport capabilities and the Generating Force segment addresses the business operations needed to train, equip and sustain the operational forces. DON's Net Centric segment is to address human and technical connectivity and interoperability.

[30]See, for example, GAO-10-846G.

Developing initial enterprise-level architecture content: All three of the military departments have partially satisfied the element associated with developing an initial enterprise-level architecture that addresses the current and target environment and a sequencing plan for transitioning from the current to the target environment. The Air Force and DON approaches to developing this enterprise architecture content involve establishing enterprise-level architecture content that is to be further supported by lower-level architectures, while Army has established three architecture segments but has not yet established an enterprise-level architecture. Consistent with these approaches, the Air Force and DON have begun to develop initial enterprise-level architecture content, but this content does not include separate views of the current and target environments and neither of the two military departments has fully established a sequencing plan that describes how the department is to transition from its current to the target environment and is based on an analysis of the gaps between these environments. Officials from these departments stated that they do not plan to distinguish between their current and target environments because they are focused on establishing enterprise architecture content that is more immediately useable (DON) and they have not been asked by executive management to establish such a distinction (Air Force).

As we have previously reported, enterprise architecture development typically occurs in an incremental fashion, whereby an initial version is developed as the foundation on which to evolve and build increasingly more comprehensive, detailed, and complete versions.[31] In addition, as we have reported,[32] sequencing plans should be based on an assessment of the differences between the current and target architectures (i.e., a gap analysis). For example, a performance gap analysis identifies performance measures (e.g., effectiveness) of a business process, highlights which performance measures are not being met in the current environment, and describes performance expectations for these measures in the target environment, thereby describing expected performance improvements to the business process. This performance gap analysis should also identify the business process

[31]See, for example, GAO-10-846G.

[32]GAO, *Department of Defense: Further Actions Needed to Institutionalize Key Business System Modernization Management Controls,* GAO-11-684 (Washington, D.C.: June 29, 2011).

activities or steps that need to be changed to achieve the future performance expectations. As such, these gap analyses identify necessary changes or adjustments in the current environment to achieve business goals and mission outcomes expected in the future environment, thereby serving as the support for related investments and activities, and also as a basis for prioritization; integration; and synchronization of decisions across the spectrum of these investments and activities.

Using an enterprise architecture methodology: None of the military departments has fully satisfied the element associated with developing its enterprise architecture products according to a defined methodology. The departments have not satisfied this element because, among other things, none of them has established a methodology to guide enterprise architecture development, maintenance, and use. Air Force officials stated that efforts to develop such a methodology have been postponed due to budget constraints and DON officials stated that the department has not developed a methodology due to its focus on other resource-intensive commitments, such as applying the current enterprise architecture content. However, as stated previously in this report, DOD has been provided with extensive resources for its IT systems environment. Army officials stated that the department's draft enterprise architecture regulation will call for the development of such a methodology. It is important for the departments to develop such a methodology, as it would provide architecture staff and stakeholders with a shared understanding of the architecture development approach, including defined steps, tasks, standards, tools, techniques, and measures that are to be used to create the specified enterprise architecture products. In addition, such a methodology would help to ensure that enterprise architecture products are, among other things, consistent, complete, aligned, integrated, and usable.

An agency that achieves this stage is well on its way to defining an enterprise architecture of sufficient scope and content that can be used to guide and constrain investments in a way that can produce targeted results, even though it may not yet have developed a version of an enterprise architecture that is ready for implementation. However, agencies that develop architectural content in Stage 3 without first addressing critical Stage 1 and 2 elements risk developing enterprise architecture products that are not usable for achieving target results (Stage 4).

Military Departments Have Yet to Complete and Use Initial Enterprise Architecture Versions for Targeted Results

Stage 4 of our EAMMF describes elements associated with completing initial enterprise architecture versions and using the architecture to achieve targeted results. Examples of these elements include linking architecture to other management disciplines, measuring and reporting the quality of enterprise architecture products, and measuring and reporting enterprise architecture results and outcomes.

The military departments' satisfaction of these Stage 4 core elements demonstrates that, among other things, they have yet to establish a meaningful basis for guiding and constraining capital investment selection and control decisions and system life cycle definition and design decisions. Specifically, they have satisfied only 15 percent, partially satisfied 39 percent, and not satisfied 45 percent of these elements. Table 5 describes the extent to which each military department has satisfied Stage 4 framework elements.

Table 5: Military Department Satisfaction of Stage 4 Framework Elements

Military department	Fully satisfied	Partially satisfied	Not satisfied
Air Force	9	55	36
Army	9	27	64
DON	27	36	36
Average	15	39	45

Source: GAO analysis of military department data.

Note: Numbers do not always add to 100 percent due to rounding.

The following examples describe the military departments' performance relative to selected Stage 4 elements.

Linking architecture to other management disciplines: All three military departments have fully satisfied the element associated with making their respective architecture programs integral to the execution of other institutional management disciplines. Specifically, the Army has demonstrated that its segment architecture efforts are linked to the execution of management disciplines associated with capability integration, acquisition, and budgeting; the Air Force demonstrated integration with its capability integration, acquisition, and budgeting disciplines; and DON demonstrated that its architecture efforts are linked to the execution of its strategic planning, capital planning, and system development efforts. Enterprise architecture is one of several interrelated institutional management disciplines that collectively provide the means for an organization to be successful in meeting its mission goals and

target outcomes. It is a contributor to many of these disciplines. In particular, it provides the bridge between strategic planning and program implementation, it informs human capital strategic planning and capital planning and investment control decision making, and it provides a critical underpinning to institutional performance management. As a result, the enterprise architecture should be an integral input into the execution of each of these management disciplines.

Enterprise architecture quality measurement: DON has fully satisfied the element associated with measuring and reporting the quality of its enterprise architecture products; Air Force has partially satisfied this element; and Army has yet to satisfy the element. Specifically, the quality of DON enterprise architecture products is assessed by a working group in accordance with a set of defined criteria and submitted for final approval to an enterprise architecture approval board. Air Force demonstrated that both its enterprise-level and subordinate architectures are subject to quality reviews that address completeness, usability, consistency, and accuracy and are reported to the appropriate officials. However, the assessments were not based on quality standards defined in an approved enterprise architecture methodology. In addition, although Army's Network architecture segment documentation states that quality control measures are to be used to determine quality, reuse, compliance, and risk, related measurements have not yet been defined. Further, according to Army officials, the quality of its other segment architecture products is not measured and reported. Realizing an enterprise architecture's value depends in large part on the quality of the products or artifacts that compose it. Accordingly, measuring and reporting the quality of enterprise architecture products relative to defined and consistently applied quality standards helps ensure that the enterprise architecture program will ultimately achieve its intended purpose.

Enterprise architecture results and outcomes: None of the military departments has partially or fully satisfied the element associated with measuring and reporting enterprise architecture results and outcomes, although all three have reported that they expect to realize future benefits from their respective architecture programs. For example, Air Force reported that it expects to achieve improved alignment between its business operations and IT as well as improved data integration within 2 to 5 years, and DON reported that it expects increased infrastructure consolidation and increased use of enterprise licenses within 2 to 5 years. What this suggests is that the real value to the military departments from developing and using enterprise architectures has yet to be realized. Our framework recognizes that a key to realizing this potential is effectively

managing department and agency enterprise architecture programs. However, knowing whether benefits and results are in fact being achieved requires having associated measures and metrics. In this regard, it is important for the military departments to measure and report enterprise architecture results and outcomes. Examples of results and outcomes to be measured include costs avoided by eliminating duplicative investments or by reusing common services and applications and improved mission performance through re-engineered business processes and modernized supporting systems.

Agencies that achieve maturity Stage 4 have a foundational set of enterprise-level and subordinate enterprise architecture products that provide a meaningful basis for informing selected investments and building greater enterprise architecture scope, content, use, and results. In addition, they have begun to demonstrate initial benefits associated with using their architecture. However, the military departments' limited satisfaction of Stage 4 elements demonstrates that, although they have begun to develop some architecture products (Stage 3), they have yet to complete initial versions of those products and use those products to achieve measurable outcomes.

Military Departments Have Yet to Expand and Evolve Enterprise Architectures and Use Them for Organizational Transformation

Stage 5 of our EAMMF describes elements associated with establishing a full suite of architecture products that can be employed as a featured decision-support tool when considering and planning large-scale organizational restructuring or transformation initiatives. Examples of these elements include ensuring that integrated repository tools and common enterprise architecture framework and methodology are used across the enterprise, enterprise-level and subordinate architectures are extended to align with external partner architectures, and all segment and/or federated architectures exist and are horizontally and vertically integrated.

The military departments' satisfaction of these Stage 5 core elements indicates that they have yet to expand and evolve the development and use of their respective enterprise architectures to support institutional transformation. Specifically, they have satisfied only 7 percent, partially satisfied 44 percent, and not satisfied 48 percent of these elements. Table 6 describes the extent to which each military department has satisfied Stage 5 framework elements.

Table 6: Military Department Satisfaction of Stage 5 Framework Elements

Military department	Fully satisfied	Partially satisfied	Not satisfied
Air Force	11	44	44
Army	0	44	56
DON	11	44	44
Average	7	44	48

Source: GAO analysis of military department data.

Note: Numbers do not always add to 100 percent due to rounding.

The following examples describe the military departments' performance relative to selected Stage 5 elements.

Integrated tools and common frameworks and methodologies: Each of the military departments has partially satisfied the element associated with ensuring that integrated repository tools and a common enterprise architecture framework and methodology are used across the enterprise. For example, Army demonstrated its use of enterprise architecture tools, but has yet to establish a common enterprise architecture framework and methodology for use across the enterprise. In addition, DON and Air Force have established tools that can serve as a common repository for their enterprise architecture products, but they have not fully established common enterprise architecture methodologies to define how architectural products will be developed. It is important for the military departments to adopt and use a common set of tools and a common framework and methodology. Doing so helps ensure that architecture products are developed and used consistently across the enterprise, which in turn further supports efforts to improve enterprisewide architecture product quality and achieve results.

Aligning enterprise architecture to external partner architectures: Each of the military departments has partially satisfied the element associated with ensuring that enterprise-level and subordinate architectures are extended to align with external partner architectures. For example, Air Force has demonstrated that it is aligned with the DOD Information Enterprise Architecture.[33] However, it has not provided

[33]The Information Enterprise Architecture is to describe the information, information resources, assets, and processes required to share information across the Department and with mission partners.

evidence that its enterprise architecture aligns with the Army and DON architectures. In addition, while DON's enterprise architecture approach is aligned with the Joint Staff's Joint Capability Areas,[34] it has not provided evidence that its enterprise architecture aligns with those of the Air Force and Army. Such alignment is critical for achieving enterprise architecture-related goals, such as identifying potentially redundant or duplicative business processes or IT systems and facilitating reuse of existing systems and services.

Integrating segment and federated architectures: While each of the military departments has begun to develop an initial version of subordinate architectures, none of them has satisfied the element associated with ensuring that all segment and/or federated architectures exist and are horizontally and vertically integrated. We have previously reported[35] that, in large part, achieving this core element is a byproduct of having met many of the previously discussed core elements related to, for example, adopting one or more enterprise architecture approaches (e.g., federation, segmentation, etc.) and employing enterprise architecture development, maintenance, and management rigor and discipline. However, the military departments have not fully satisfied critical foundational elements, such as the element associated with establishing an enterprise architecture development and maintenance methodology or measuring and reporting subordinate architecture alignment with the enterprise-level architecture. While development of subordinate architectures, as discussed earlier, typically occurs incrementally based on institutional needs and priorities, the ultimate goal remains to develop each of the subordinate architectures and to ensure that they collectively form a coherent family of parent and child architectures that are integrated both horizontally and vertically. As with the previously-cited example, developing such integrated architecture products is important for supporting the organization's ability to use these products as tools for organizational transformation by, for example, identifying potentially redundant or duplicative business processes or IT systems and facilitating reuse of existing systems and services.

[34]The Joint Capability Areas represent collections of similar DOD functions that are intended to support, among other things, investment decision making, portfolio management, and capabilities-based planning.

[35]GAO-10-846G.

While enterprise architecture development and use offers the potential to achieve important departmentwide benefits, such as increased use of enterprise licenses and improved data integration (Stage 4), addressing the EAMMF's Stage 5 elements expands these potential benefits to supporting large-scale departmentwide restructuring and transformation. Accordingly, addressing Stage 5 elements would better position the military departments to support ongoing efforts to identify DOD efficiencies and savings[36] by informing efforts to look across the military departments and identify ways in which DOD can improve effectiveness and efficiency while continuing to meet mission demands.

Military Departments Have Taken Limited Steps to Continuously Improve Their Respective Enterprise Architecture Programs and Use Enterprise Architecture for Corporate Optimization

Stage 6 of our EAMMF describes elements that are focused on continuous improvement of the quality of the suite of enterprise architecture products and the people, processes, and tools used to govern their development, maintenance, and use. Examples of these elements include continuously improving enterprise architecture program capabilities and products as well as enterprise architecture methodologies and tools and ensuring that the enterprise architecture informs strategic planning and policy formulation.

The military departments' satisfaction of these Stage 6 core elements indicates that they have begun taking steps to improve their respective enterprise architecture program and use their respective enterprise architectures for enterprise-level optimization, but much still remains to be accomplished. Specifically, they have satisfied 10 percent, partially satisfied 43 percent, and not satisfied 48 percent of these elements. Table 7 describes the extent to which each military department has satisfied Stage 6 framework elements.

[36]In May 2010, the Secretary of Defense announced the need for DOD to reduce overhead costs and subsequently called for a 5-year effort to cut $100 billion from the department's budget in order to finance sustainment of the current force and modernize its weapons portfolio.

Table 7: Military Department Satisfaction of Stage 6 Framework Elements

Military department	Fully satisfied	Partially satisfied	Not satisfied
Air Force	14	43	43
Army	0	43	57
DON	14	43	43
Average	10	43	48

Source: GAO analysis of military department data.

Note: Numbers do not always add to 100 percent due to rounding.

The following examples describe the military departments' performance relative to selected Stage 6 elements.

Improving program capabilities and products: Air Force and DON have each fully satisfied the element associated with ensuring that enterprise architecture continuous improvement efforts reflect the results of external assessments, while Army has not yet satisfied this element. For example, according to DON officials, our 2008 assessment of the department's enterprise architecture program has been leveraged to make program capability and product improvements, such as establishing a formalized enterprise architecture governance structure; a policy for enterprise architecture development and maintenance; an IT investment process that includes compliance assessments with DON's architecture; and a set of criteria for measuring the quality of its products. Similarly, Air Force leveraged our prior report to make program improvements, such as placing enterprise architecture products under configuration management. All efforts to continuously improve the enterprise architecture program capabilities and products should leverage the results of external assessments performed by organizations external to the program, including assessments periodically performed by us, OMB, and others to demonstrate measurable accomplishments.

Improving methodologies and tools: Each of the military departments has partially satisfied the element associated with continuously improving enterprise architecture methodologies and tools. For example, each military department has mechanisms in place to improve existing enterprise architecture tools. However, none of the military departments has fully developed an enterprise architecture development and maintenance methodology that can be used as a baseline for improvements. Continuously improving enterprise architecture methodologies and tools helps to ensure that existing methodologies and tools continue to support changing organizational needs.

Strategic planning and policy formulation: None of the military departments has either fully or partially satisfied the element associated with ensuring that the enterprise architecture is used by executive leadership to inform organization strategic planning and policy formulation. The enterprise architecture provides the information needed to bridge the gap between an organization's strategic plans and the programs it implements. As such, the architecture has traditionally been informed and constrained by these plans and the institutional policies that govern the plans' implementation. As an architecture program fully matures, however, a bidirectional relationship should exist whereby it helps to inform the same strategic plans and institutional policies to which it is integral to implementing. In particular, the enterprise architecture can identify the related organizational business process, performance, information, service, technology, and security strengths, weaknesses, and opportunity gaps that should be considered for inclusion in strategic plans and institutional policies. For example, emerging technologies that are reflected in the enterprise architecture's target view can serve as the catalyst for introducing new, or for modifying existing, strategic goals and objectives, and/or the timelines for achieving them.

Agencies that achieve this stage of maturity have established an enterprisewide blueprint to inform strategic planning and decision making and "on-the-ground" implementation of these changes through a range of capital investment and maintenance projects and other enterprise-level initiatives. While each of the military departments has taken steps to establish and manage its respective enterprise architecture program and develop initial enterprise architecture content that could eventually be used as input into organizational strategic planning and serve as the basis for continuous improvement activities, incomplete program management mechanisms and enterprise architecture content limit the extent to which either of these ends can be achieved.

Long-Standing Enterprise Architecture Management Challenges Have Not Been Fully Addressed

As we have previously reported,[37] long-standing governmentwide enterprise architecture management challenges include organizational parochialism and cultural resistance, ensuring adequate funding, obtaining staff skilled in the architecture discipline, and having department or agency senior leaders that understand the importance and role of the

[37] GAO-06-831.

enterprise architecture. Military department officials indicated that these management challenges continue to limit their respective enterprise architecture programs. In particular, regarding cultural resistance, a senior Air Force architecture official stated that the department's major programs resist adapting to enterprisewide approaches to meeting their technical needs. With respect to adequacy of funding, Air Force and DON representatives provided examples of activities that could not be completed due to a lack of funding for enterprise architecture. For example, Air Force officials stated that the department has postponed the development of an updated enterprise architecture methodology due to limited funding. Nevertheless, as stated previously in this report, DOD has been provided with considerable resources for its IT systems environment and architecture budgetary needs have not been identified and justified through reliable cost estimating and expected program benefits. Concerning skilled staff, DON and Air Force officials identified as a challenge identifying enterprise architecture staff who possess both business and technical skills. Lastly, with regard to senior leadership understanding, Army architecture officials cited the difficulty of getting senior leaders to understand the importance of having an enterprise architecture and take a holistic view of the entire military department enterprise.

The continued existence of the management challenges described has contributed to the status of the military departments' enterprise architecture programs, whereby the majority of EAMMF elements have yet to be fully satisfied. Moreover, the long-standing nature of these challenges indicates that the departments' leaders have not yet committed to effective development and use of enterprise architecture as described in our EAMMF.

Conclusions

Although the Air Force, Army, and DON each have long-standing efforts to develop enterprise architectures, the military departments have much to do before they have enterprise architectures that are fully developed and effectively managed. In general, the departments have fully satisfied certain elements related to establishing an institutional commitment to enterprise architecture and developing initial architecture content. However, the departments generally have not fully satisfied framework elements that are associated with establishing the foundation for architecture management (including the development of a plan to manage the architecture program), completing and using initial architecture content, expanding and evolving the enterprise architecture, and continuously improving their architectures. This pattern of core element

satisfaction indicates that the military departments' respective enterprise architecture programs are at risk of achieving only limited benefits. Further, the military departments have been limited in their ability to overcome long-standing enterprise architecture management challenges, thus indicating a lack of organizational commitment to effective enterprise architecture development and use.

Without fully developed and effectively managed enterprise architectures and a plan, the Air Force, Army, and DON do not have the needed road maps for transforming their business processes and modernizing their supporting systems to minimize overlap and maximize interoperability. Further, because the military departments do not have the robust enterprise architectures that DOD's federated architecture approach depends on, the department at large is also without a complete road map to effectively guide its transformation.

Establishing such a road map is critical to DOD transformation. While DOD has been provided with considerable resources for its IT systems environment, the department is not managing its systems in a consistent, repeatable, and effective manner that, among other things, maximizes mission performance while minimizing or eliminating system overlap and duplication. Because DOD is provided with over $30 billion each year for its IT systems environment, the potential for identifying and avoiding the costs associated with duplicative functionality across its IT investments is significant.

Recommendation for Executive Action

To ensure that the military departments establish commitments to fully develop and effectively manage their enterprise architectures, we recommend that the Secretaries of the Air Force, Army, and Navy each expeditiously provide to the congressional defense committees a plan that identifies milestones for their respective department's full satisfaction of all of our Enterprise Architecture Management Maturity Framework elements. In the event that a military department does not intend to fully satisfy all elements of our framework, the plan should include a rationale for why the department deems any such element(s) to be not applicable.

Agency Comments and Our Evaluation

We received written comments on a draft of this report from DOD. In the comments, which are reprinted in appendix VI, the department partially concurred with our recommendation. Specifically, the DOD and Army CIOs concurred with the recommendation, while the Air Force and DON CIOs did not concur.

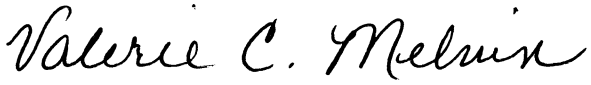
In this regard, DOD stated that both Air Force and DON believe that GAO's EAMMF provides a comprehensive set of elements associated with the development and implementation of a robust enterprise architecture program for a federal agency or organization. The department added, however, that the Air Force and DON do not have a valid business case that would justify the implementation of all 59 elements of our framework. Instead, according to DOD, in today's fiscally constrained environment, Air Force and DON have chosen to gradually implement selected elements of the framework which are most useful in implementing optimized, secure, and cost effective IT systems and capabilities.

Due to the large and complex nature of the DOD enterprise, we determined that all 59 elements of the framework apply to the military department enterprise architecture programs. However, our recommendation does provide the military departments with the flexibility of providing a rationale or business case in their plans that would justify why the department(s) deems any of the 59 elements to be not applicable. We do not agree that fiscal constraints are a valid reason for limiting the Air Force and DON enterprise architecture programs to less than full satisfaction of the framework. DOD has been provided with over $30 billion annually for its IT systems environment, but it is not managing its systems in a consistent, repeatable, and effective manner that, among other things, maximizes mission performance while minimizing or eliminating system overlap and duplication. This, in addition to the large and complex nature of the DOD enterprise, provides compelling reasons for them to establish commitments to fully satisfy the framework elements. We therefore believe our recommendation remains valid as stated.

DOD also provided technical comments on this report, which have been incorporated as appropriate.

We are sending copies of this report to appropriate congressional committees; the Director, Office of Management and Budget; the Secretary of the Air Force; Secretary of the Army; and the Secretary of the Navy. This report will also be available at no charge on our Web site at http://www.gao.gov.

If you or your staffs have any questions on matters discussed in this report, please contact me at (202) 512-6304 or melvinv@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made major contributions to this report are listed in appendix VII.



Valerie C. Melvin
Director
Information Management and Human Capital Issues

Appendix I: Objective, Scope, and Methodology

Our objective was to assess the status of enterprise architecture efforts at the Departments of the Air Force, Army, and Navy. To address this objective, we asked each department to identify responsible architecture officials and requested that the identified officials self-assess their respective department's architecture programs relative to the 59 core elements contained in version 2.0 of our Enterprise Architecture Management Maturity Framework (EAMMF).[1] Specifically, we asked the officials to indicate whether their respective department architecture programs fully satisfied, partially satisfied, or did not satisfy each core element. We also asked the officials to provide documentation in support of their self assessments. To instruct the officials in preparing their assessments, we provided the following guidance:

To fully satisfy a core element, sufficient documentation must be provided to permit us to verify that all applicable aspects of the core element are met. To partially satisfy a core element, sufficient documentation must be provided to permit us to verify that at least some aspects of the core element are met. Core elements that are applicable and are neither fully nor partially satisfied will be judged to be not satisfied.

Subsequently, we independently assessed each department's architecture program relative to the 59 EAMMF core elements using the self assessments and supporting documentation as a starting point. We then corroborated the assessment with supporting documentation, sought additional information as necessary through interviews with the departments' architecture officials, obtained and reviewed additional documentation as appropriate, and refined our determinations about the degree to which each core element was satisfied. In performing our analyses, we used the same criteria for determining whether a given core element was fully satisfied, partially satisfied, or not satisfied that we had instructed the departments to use. Finally, we shared with the military departments the preliminary versions of the analyses that appear in this report as appendices III, IV, and V, and made further adjustments, as appropriate, based on additional discussions and supporting documentation. We also solicited information from each department on long-standing challenges to the success of enterprise architecture in the areas of funding, cultural resistance, senior leadership, and staff skills.

[1]GAO, *Organizational Transformation: A Framework for Assessing and Improving Enterprise Architecture Management (Version 2.0)*, GAO-10-846G (Washington, D.C.: August 2010).

The results presented in this report reflect the state of department and agency architecture programs as of August 1, 2011.

In performing our analyses, we interviewed officials and supporting contractors from the Departments of the Air Force, Army, and Navy, including the Offices of the Chief Information Officer. To gain additional insights into the military departments' enterprise architecture programs, we also interviewed officials in the Office of the Secretary of Defense.

We conducted our work in the Washington, D.C., metropolitan area from October 2010 through September 2011, 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.

Appendix II: EAMMF Table

Table 8 summarizes the framework elements in version 2.0 of our Enterprise Architecture Management Maturity Framework (EAMMF).

Table 8: Summary of EAMMF Version 2.0 Core Elements Categorized by Stage

Stages	Core element
Stage 0	No elements.
Stage 1: Establishing enterprise architecture institutional commitment and direction	Written and approved organization policy exists for enterprise architecture development, maintenance, and use.
	Executive committee representing the enterprise exists and is responsible and accountable for enterprise architecture.
	Executive committee is taking proactive steps to address enterprise architecture cultural barriers.
	Executive committee members are trained in enterprise architecture principles and concepts.
	Chief architect exists.
	Enterprise architecture purpose is clearly stated.
	Enterprise architecture framework(s) is adopted.
	Enterprise architecture performance and accountability framework is established.
Stage 2: Creating the management foundation for enterprise architecture development and use	Enterprise architecture budgetary needs are justified and funded.
	Enterprise architecture program office(s) exists.
	Key program office leadership positions are filled.
	Program office human capital plans exist.
	Enterprise architecture development and maintenance methodology exists.
	Automated enterprise architecture tools exist.
	Enterprise architecture program management plan exists and reflects relationships with other management disciplines.
	Work breakdown structure and schedule to develop enterprise architecture exist.
	Enterprise architecture segments, federation members, and/or extended members have been identified and prioritized.
	Program office readiness is measured and reported.
Stage 3: Developing initial enterprise architecture versions	Organization business owner and CXO representatives are actively engaged in architecture development.
	Enterprise architecture human capital plans are being implemented.
	Program office contractor support needs are being met.
	Program office staff are trained in enterprise architecture framework, methodology, and tools.
	Methodologies and tools exist to determine investment compliance with corporate and subordinate architectures.
	Methodologies and tools exist to determine subordinate architecture alignment with the corporate enterprise architecture.
	Enterprise architecture-related risks are proactively identified, reported, and mitigated.

Stages	Core element
	Initial versions of corporate “as-is” and “to-be” enterprise architecture and sequencing plan are being developed.
	Initial version of corporate enterprise architecture describing the enterprise in terms of performance, business, data, services, technology, and security is being developed.
	One or more segment and/or federation member architectures is being developed.
	Architecture products are being developed according to the enterprise architecture content framework.
	Architecture products are being developed according to a defined enterprise architecture methodology.
	Architecture products are being developed using enterprise architecture tools.
	Architecture development progress is measured and reported.
Stage 4: Completing and using an initial enterprise architecture version for targeted results	Executive committee has approved the initial version of corporate enterprise architecture.
	Key stakeholders have approved the current version of subordinate architectures.
	Enterprise architecture is integral to the execution of other institutional management disciplines.
	Program office human capital needs are met.
	Initial versions of corporate “as-is” and “to-be” enterprise architecture and sequencing plan exist.
	Initial version of corporate enterprise architecture captures performance, business, data, services, technology, and security views.
	One or more segment and/or federation member architectures exists and is being implemented.
	Enterprise architecture product quality is measured and reported.
	Enterprise architecture results and outcomes are measured and reported.
	Investment compliance with corporate and subordinate architectures is measured and reported.
	Subordinate architecture alignment with the corporate enterprise architecture is measured and reported.
Stage 5: Expanding and evolving the enterprise architecture and its use for institutional transformation	Organization head has approved current version of the corporate enterprise architecture.
	Organization component heads or segment owners have approved current version of their respective subordinate architectures.
	Integrated repository tools and common enterprise architecture framework and methodology are used across the enterprise.
	Corporate and subordinate architecture program offices operate as a single virtual office that shares resources enterprisewide.
	Corporate enterprise architecture and sequencing plan are enterprisewide in scope.
	Corporate enterprise architecture and sequencing plan are aligned with subordinate architectures.
	All segment and/or federated architectures exist and are horizontally and vertically integrated.
	Corporate and subordinate architectures are extended to align with external partner architectures.

Stages	Core element
	Enterprise architecture products and management processes are subject to independent assessment.
Stage 6: Continuously improving the enterprise architecture and its use to achieve corporate optimization	Enterprise architecture is used by executive leadership to inform organization strategic planning and policy formulation.
	Enterprise architecture human capital capabilities are continuously improved.
	Enterprise architecture methodologies and tools are continuously improved.
	Enterprise architecture management processes are continuously improved and reflect the results of external assessments.
	Enterprise architecture products are continuously improved and updated.
	Enterprise architecture quality and results measurement methods are continuously improved.
	Enterprise architecture continuous improvement efforts reflect the results of external assessments.

Source: GAO-10-846G.

Appendix III: Department of the Air Force

The Department of the Air Force fully satisfied 12, partially satisfied 28, and did not satisfy 19 of the 59 elements described in our EAMMF. Table 9 summarizes the extent to which the Air Force has addressed the core elements described in each stage of the EAMMF. Table 10 describes the extent to which the department satisfied each element.

Table 9: Air Force Satisfaction of Core Elements within Each Stage

Stage	Satisfied	Partially satisfied	Not satisfied
1	50	38	13
2	10	50	40
3	29	50	21
4	9	55	36
5	11	44	44
6	14	43	43
Average	20	47	32

Source: GAO analysis of information provided by Air Force.

Note: Numbers do not always add to 100 percent due to rounding.

Table 10: Air Force Satisfaction of EAMMF Core Elements

Core element	Satisfied?	Our analysis
Stage 1		
Core element 1: Written and approved organization policy exists for enterprise architecture development, maintenance, and use.	Yes	Air Force has written policies, approved by the head of the Air Force that address enterprise architecture development, maintenance, and use. These policies identify the major players responsible for the Air Force's enterprise architecture efforts (e.g., the Air Force Chief Information Officer (CIO) and heads of the department's Major Commands); define what an enterprise architecture includes (i.e., a baseline architecture, a target architecture, and a sequencing plan); and set direction on the use of enterprise architecture (e.g., inform, guide, and support Air Force decision making).
Core element 2: Executive Committee representing the enterprise exists and is responsible and accountable for enterprise architecture.	Yes	In June 2011, the department established the Air Force CIO Executive Council as the executive-level committee that represents the enterprise and is responsible for approving its enterprise architecture. The Executive Council is supported by two subordinate boards whose responsibilities include overseeing IT capital planning and reviewing new versions of the enterprise architecture.
Core element 3: Executive Committee is taking proactive steps to address enterprise architecture cultural barriers.	Partial	The Air Force Architecting Division has taken steps to address enterprise architecture cultural barriers. For example, the Architecting Division issued an enterprise architecture communications plan to, among other things, improve its efforts to integrate architecture into the department's decision-making processes. However, Air Force did not provide evidence indicating that the enterprise architecture Executive Committee had taken steps to address enterprise architecture cultural barriers.

Core element	Satisfied?	Our analysis
Core element 4: Executive Committee members are trained in enterprise architecture principles and concepts.	Partial	Enterprise architecture training is available to all Air Force employees. However, according to Air Force enterprise architecture officials, department executives are not required or expected to take enterprise architecture training. Instead, they are provided with high-level briefings on the purpose and use of enterprise architecture from enterprise architecture subject matter experts. According to the Enterprise Architecting Division head, department executives do not need such training because it is the responsibility of department architects to understand enterprise architecture principles and concepts.
Core element 5: Chief architect exists.	Yes	As the Air Force Chief Architect, the Director of Policy, Planning, and Resources is responsible for developing and maintaining the Air Force enterprise architecture. The Air Force Chief Architect also serves as the head of the CIO Group, a subcommittee that reports directly to the Air Force's enterprise architecture Executive Committee, and has experience in the IT and business sides of the organization.
Core element 6: Enterprise architecture purpose is clearly stated.	Partial	Air Force has defined the purpose of its enterprise architecture, which is included in information distributed to key stakeholders. This purpose is broadly written to support the department's goals and objectives. However, this purpose was approved by the CIO rather than the Air Force CIO Executive Council. According to the recently updated Air Force enterprise architecture Executive Committee charter, the committee will approve future versions of the department's enterprise architecture, which have previously included descriptions of the enterprise architecture's purpose.
Core element 7: Enterprise architecture framework(s) is adopted.	Yes	Air Force has established an enterprise architecture framework that documents the suite of enterprise-level enterprise architecture artifacts to be developed, used, and maintained. The framework also defines the overall structure of the Air Force enterprise architecture, such as the conceptual relationships among the various levels of architecture (e.g., enterprise-level and segment architectures).
Core element 8: Enterprise architecture performance and accountability framework is established.	No	The Air Force instruction 33-401 describes roles and responsibilities for key enterprise architecture stakeholders, such as the CIO, Chief Architect, and Air Force Major Commands. However, Air Force has yet to develop a framework that provides the means and metrics for ensuring that these roles and responsibilities are fulfilled.
Stage 2		
Core element 9: Enterprise architecture budgetary needs are justified and funded.	Partial	According to Air Force officials, its annual budget request has enabled them to maintain both government and contractor staff. These staff have worked on activities such as creating enterprise architecture products and the approval of segment architectures. However, they did not provide evidence that funding requests are based on reliable cost estimates and justified based on expected benefits, and Air Force officials stated that the implementation of key enterprise architecture initiatives (e.g., Air Force Enterprise Architecture 2015) have been postponed due to limited funds.

Core element	Satisfied?	Our analysis
Core element 10: Enterprise architecture program office(s) exists.	Partial	Air Force has established an Architecting Division within its Office of the CIO. This division is responsible for performing some activities that are typically associated with a program office. For example, the division has issued enterprise architecture configuration management guidance and work breakdown structures for developing new versions of its enterprise-level architecture. However, according to Air Force officials, the department does not consider the Architecting Division to be a program office and it has not executed program management tasks associated with a program office (e.g., establishing a program management plan).
Core element 11: Key program office leadership positions are filled.	No	Air Force has recently filled the Enterprise Architecting Division Chief position. In addition, according to Air Force, Core Function Lead Integrators will be assigned to lead each segment architecture. According to Air Force officials, two have been assigned; however, the department has yet to provide evidence to show that these positions have been filled. Moreover, the Architecting Division staff are not specifically assigned to key activities such as risk management or quality assurance.
Core element 12: Program office human capital plans exist.	No	According to Air Force officials, the department has not developed an enterprise architecture human capital plan. Moreover, the former Architecting Division head stated that the department does not plan to develop such a plan because enterprise architecture is not a formally established career field within the federal government.
Core element 13: Enterprise architecture development and maintenance methodology exists.	Partial	Although some elements of a development and maintenance methodology can be found in existing enterprise architecture program documents, Air Force has not yet developed an enterprise architecture development and maintenance methodology that includes defined steps, tasks, standards, tools, techniques, and measures that govern how the architecture is to be developed and maintained. According to Air Force officials, efforts to develop such a methodology have been postponed due to budget constraints.
Core element 14: Automated enterprise architecture tools exist.	Yes	Air Force uses various automated enterprise architecture tools to capture information described by its enterprise architecture framework and enable communication of information contained in its architecture products to enterprise architecture stakeholders. For example, Air Force uses Troux Architect to document the relationship of architecture products in and between each of the five main Air Force enterprise architecture reference models.
Core element 15: Enterprise architecture program management plan exists and reflects relationships with other management disciplines.	No	According to the Architecting Division, Air Force produces an annual road map from which goals and schedules for the division are drawn. However, a plan for managing the Air Force's enterprise architecture program that defines the management structures, controls, disciplines, roles, and accountability mechanisms included in our EAMMF does not currently exist.
Core element 16: Work breakdown structure and schedule to develop enterprise architecture exist.	Partial	Air Force provided a work breakdown structure that identified high-level tasks, activities, and events needed to develop updated versions of its enterprise architecture. Air Force Architecting Division officials stated that the work breakdown structure, which includes a schedule, is based on prior year work breakdown structures. However, the work breakdown structure and schedule are not created based on input from an enterprise architecture development methodology or program plan, as these documents do not exist.

Core element	Satisfied?	Our analysis
Core element 17: Enterprise architecture segments, federation members, and/or extended members have been identified and prioritized.	Partial	Air Force has identified its enterprise architecture subordinate architectures (i.e., segments). However, the department has not formally prioritized these subordinate architectures. According to Air Force, Major Commands are responsible for developing their respective subordinate architectures when each Major Command determines that such architecture development is needed.
Core element 18: Program office readiness is measured and reported.	No	Air Force does not consider its Architecting Division to be a formal enterprise architecture program office. In addition, the department has yet to measure the extent to which people, processes, and tools enablers have been put in place and report this readiness information to the enterprise architecture Executive Committee and Chief Architect.
Stage 3		
Core element 19: Organization business owner and CXO representatives are actively engaged in architecture development.	Partial	Representatives of the recently established enterprise architecture Executive Committee have been engaged in architecture development, and an Air Force policy document requires Major Commands and other senior officials to play a lead role in developing subordinate architectures and other enterprise architecture products for which they are responsible. However, Air Force has not yet formally assigned subordinate architectures to specific Major Commands.
Core element 20: Enterprise architecture human capital plans are being implemented.	No	Air Force has not developed an enterprise architecture human capital plan. Air Force enterprise architecture officials stated that such a plan is not applicable because enterprise architecture is not a formal career field within the federal government.
Core element 21: Program office contractor support needs are being met.	Partial	While Air Force has not developed an enterprise architecture human capital plan to guide its use of contractors, it does leverage contractors to support the development of its enterprise architecture and has mechanisms in place to monitor contractor performance.
Core element 22: Program office staff are trained in enterprise architecture framework, methodology, and tools.	Partial	According to an Air Force official, enterprise architecture training that includes, among other things, an understanding of enterprise architecture basics, such as common enterprise architecture views and an introduction to the DOD Architecture Framework and Air Force enterprise architecture is available to staff in the Office of the Chief Architect. However, attendance is not mandatory.
Core element 23: Methodologies and tools exist to determine investment compliance with corporate and subordinate architectures.	Partial	Air Force has begun to develop elements of a methodology to determine investment compliance with the department's enterprise architecture. For example, according to the Air Force Architecting Division, for each IT investment, the Architecting Division completes a common checklist to ensure its compliance with the Air Force enterprise architecture and provides each investment with a score of either pass or fail. However, the Air Force's approach does not provide for exceptions to architecture compliance on the basis of analytical justification that are captured in documented enterprise architecture waivers and used to update the enterprise architecture.
Core element 24: Methodologies and tools exist to determine subordinate architecture alignment with the corporate enterprise architecture.	Partial	Air Force has begun to develop elements of a methodology to determine subordinate architecture alignment with the enterprise-level architecture. For example, each subordinate architecture is assessed using a scorecard that evaluates its compliance with the Air Force enterprise architecture and provides each architecture with a numerical score. However, Air Force did not provide documentation to support that the status of alignment (including risks) among architectures needs to be disclosed to, among others, the Executive Committee.

Core element	Satisfied?	Our analysis
Core element 25: Enterprise architecture-related risks are proactively identified, reported, and mitigated.	No	The Air Force's enterprise architecture concept of operations identifies categories of risks related to organizational use and acceptance of enterprise architecture. However, Air Force did not provide evidence that enterprise architecture program risks are proactively identified, reported, and mitigated.
Core element 26: Initial versions of corporate "as-is" and "to-be" enterprise architecture and sequencing plan are being developed.	Partial	Air Force has developed initial versions of its enterprise-level architecture and sequencing plan, including architecture products such as its current business reference model. However, the department has not developed separate current and target enterprise architectures.
Core element 27: Initial version of corporate enterprise architecture describing the enterprise in terms of performance, business, data, services, technology, and security is being developed.	Yes	Initial versions of the Air Force enterprise architecture include performance, business, data, services, and technology reference models. In addition, security is being addressed in the technical reference model.
Core element 28: One or more segment and/or federation member architectures is being developed.	Yes	Air Force has developed subordinate architectures. For example, version 1.0 of the Space Domain architecture was approved on September 20, 2010.
Core element 29: Architecture products are being developed according to the enterprise architecture content framework.	Yes	Initial versions of the enterprise-level and subordinate architectures are consistent with Air Force's enterprise architecture content framework.
Core element 30: Architecture products are being developed according to a defined enterprise architecture methodology.	No	According to Air Force officials, development of an Air Force-unique methodology governing how Air Force architecture products at all levels are to be developed, maintained, and validated has been put on hold due to budget constraints (see element 13).
Core element 31: Architecture products are being developed using enterprise architecture tools.	Yes	Air Force is developing architecture products using the enterprise architecture tools described in element 14.
Core element 32: Architecture development progress is measured and reported.	Partial	The Air Force Architecting Division measures the state of the enterprise-level architecture and reports this information to the Chief Architect on a quarterly basis. According to Air Force officials, these measurements are based on a planning document developed annually to guide the work of the Architecting Division. However, this planning document is not based on an enterprise architecture program plan. In addition, according to Air Force officials, the progress is reported to the Chief Architect and not to other enterprise architecture stakeholders, such as the Executive Committee. Instead, according to Air Force officials, the Air Force has briefed enterprise architecture concepts and status of key activities regarding the Air Force enterprise architecture to the enterprise architecture Executive Committee.
Stage 4		
Core element 33: Executive Committee has approved the initial version of corporate enterprise architecture.	No	The Air Force enterprise architecture has been approved by the CIO, but not by the Executive Committee. According to officials and its recently updated charter, this committee, the CIO Executive Council, will approve all subsequent versions of the Air Force enterprise architecture.
Core element 34: Key stakeholders have approved the current version of subordinate architectures.	No	According to Air Force officials, the latest versions of subordinate architectures (i.e., segment architectures) have been approved by the Architecting Division. However, the department did not provide evidence to demonstrate that key stakeholders have approved the latest versions of subordinate architectures.

Core element	Satisfied?	Our analysis
Core element 35: Enterprise architecture is integral to the execution of other institutional management disciplines.	Yes	Air Force demonstrated that enterprise architecture is integral to the execution of other institutional management disciplines, such as the Joint Capabilities Integration Development System.
Core element 36: Program office human capital needs are met.	No	Air Force has yet to develop a human capital plan that would identify the knowledge, skills, and abilities needed to execute the department's enterprise architecture program plans and schedules. According to Air Force officials, vacancies in the Architecting Division are filled on a case-by-case basis, following OMB guidelines for civilians and based on Air Force needs.
Core element 37: Initial versions of corporate "as-is" and "to-be" enterprise architecture and sequencing plan exist.	Partial	Air Force has developed initial versions of its enterprise-level architecture. However, the department has not developed separate enterprise-level current and target enterprise architecture products. In addition, the enterprise sequencing plan does not include a gap analysis, which is essential to assessing the differences between the current and target environments.
Core element 38: Initial version of corporate enterprise architecture captures performance, business, data, services, technology, and security views.	Partial	Air Force has developed initial versions of its enterprise-level architecture that captures business, performance, data, services, technology, and security information. However, the department has not developed separate enterprise-level current and target enterprise architecture products.
Core element 39: One or more segment and/or federation member architectures exists and is being implemented.	Partial	Air Force has developed Space Domain and Agile Combat Support architecture products. However, the department did not provide evidence that it has implemented these architectures.
Core element 40: Enterprise architecture product quality is measured and reported.	Partial	Air Force demonstrated that both its enterprise-level and subordinate architectures are subject to quality reviews that address completeness, usability, consistency, and accuracy and are reported to the appropriate officials. However, the assessments are not based on an approved enterprise architecture methodology that outlines quality expectations.
Core element 41: Enterprise architecture results and outcomes are measured and reported.	No	Air Force officials stated that enterprise architecture results are measured and reported for the department's business mission area. Specifically, the department provided its annual report on business mission area IT investments. However, these metrics do not demonstrate results and outcomes that measure the strategic mission value of the Air Force enterprise architecture. Air Force officials stated the department has yet to develop additional metrics that demonstrate enterprise architecture results due in part to a lack of industry-recognized enterprise architecture results metrics.
Core element 42: Investment compliance with corporate and subordinate architectures is measured and reported.	Partial	Air Force provided evidence showing that investment compliance with its enterprise architecture is measured against defined criteria. According to Air Force officials, compliance is also reported to relevant Investment Review Boards. However, the department did not demonstrate that waivers are issued in the event of non-compliance or that investment compliance with subordinate architectures is measured and reported.
Core element 43: Subordinate architecture alignment with the corporate enterprise architecture is measured and reported.	Partial	Air Force provided evidence that subordinate architecture alignment with the enterprise-level architecture is measured. However, Air Force did not provide documentation to validate that the reports are provided to its enterprise architecture Executive Committee and the reports do not identify areas at the subordinate level that are different from the enterprise-level architecture and that may require a waiver.

Core element	Satisfied?	Our analysis
Stage 5		
Core element 44: Organization head has approved current version of the corporate enterprise architecture.	Yes	The department's CIO has approved the latest version of the Air Force enterprise architecture. An Air Force instruction, by order of the organization head, delegates approval of the enterprise architecture to the CIO and Chief Architect.
Core element 45: Organization component heads or segment owners have approved current version of their respective subordinate architectures.	No	According to an Air Force policy document, subordinate architectures should be approved by designated representatives of their architecture owners prior to their certification. In addition, according to an official within the Air Force Architecting Division, current versions of segment architectures were approved by either the Air Force Chief Architect or Deputy Chief Architect. However, Air Force officials have yet to provide evidence showing that newly-created Service Core Function-level architectures have been approved by their respective organization component heads or segment owners.
Core element 46: Integrated repository tools and common enterprise architecture framework and methodology are used across the enterprise.	Partial	While Air Force uses an integrated enterprise architecture repository and has established a common enterprise architecture framework, it does not have a documented methodology governing how its architecture products are to be developed.
Core element 47: Corporate and subordinate architecture program offices operate as a single virtual office that shares resources enterprisewide.	No	Air Force has not established a formal enterprise-level architecture program office and, according to Air Force officials, the department's architecture offices are not designed to operate as a single virtual office.
Core element 48: Corporate enterprise architecture and sequencing plan are enterprisewide in scope.	Partial	The Air Force enterprise architecture is enterprisewide in scope. However, the department has not developed separate enterprise-level current and target enterprise architecture products. In addition, the Air Force sequencing plan is limited to a sequencing of systems and the enterprise architecture does not include gaps at the enterprise level.
Core element 49: Corporate enterprise architecture and sequencing plan are aligned with subordinate architectures.	No	While Air Force has criteria intended to determine if a subordinate architecture is positioned to be federated with its enterprise-level architecture, it has not demonstrated that its enterprise-level architecture and sequencing plan are aligned with subordinate architectures (see element 43).
Core element 50: All segment and/or federated architectures exist and are horizontally and vertically integrated.	No	Air Force did not demonstrate that all segment and/or federated architectures exist. For example, all Service Core Function architectures have not been fully developed. Accordingly, its architectures are not yet horizontally and vertically integrated.
Core element 51: Corporate and subordinate architectures are extended to align with external partner architectures.	Partial	Air Force has begun to demonstrate that its enterprise-level and subordinate architectures are extended to align with external partner architectures. For example, the Air Force enterprise architecture has been certified by DOD as meeting the requirements for aligning with the DOD Information Enterprise Architecture. However, Air Force did not provide evidence that its enterprise architecture aligns with other external partner architectures (e.g., Army, DON).
Core element 52: Enterprise architecture products and management processes are subject to independent assessment.	Partial	The Air Force Audit Agency conducted a review of subordinate architectures in 2011. In addition, according to a department official, an assessment of the Air Force enterprise architecture was performed by the DOD Federated Architecture Council to determine whether the Air Force enterprise architecture was "fit for federation" at DOD. However, the Air Force Audit Agency review did not address the enterprise-level Air Force enterprise architecture. In addition, no independent assessments of the enterprise architecture and management processes have been performed by entities accountable to the Air Force CIO Executive Council.

Core element	Satisfied?	Our analysis
Stage 6		
Core element 53: Enterprise architecture is used by executive leadership to inform organization strategic planning and policy formulation.	No	Air Force enterprise architecture officials have yet to provide evidence demonstrating that the enterprise architecture is used by executive leadership to inform organization strategic planning and policy formulation.
Core element 54: Enterprise architecture human capital capabilities are continuously improved.	No	According to an official in the Architecting Division, enterprise architecture human capital needs are managed on an individual basis by the development and use of individual development plans. However, Air Force did not provide evidence to demonstrate that it periodically reevaluates its enterprise-level and subordinate existing enterprise architecture human capital capabilities relative to its future needs or uses periodic gap analyses to take proactive steps to fill knowledge and skill gaps through training, hiring, and contracting.
Core element 55: Enterprise architecture methodologies and tools are continuously improved.	Partial	Air Force has mechanisms in place to evaluate its enterprise architecture tools. For example, the department conducted an enterprise architecture tool assessment survey that requested information from staff regarding tool use and performance. However, the creation of Air Force's development and maintenance methodology has been postponed due to budget concerns.
Core element 56: Enterprise architecture management processes are continuously improved and reflect the results of external assessments.	Partial	Air Force officials provided evidence that its enterprise-level architecture management processes were evaluated. In addition, department officials stated that the subordinate architecture certification process has been periodically assessed and revised. However, Air Force did not provide evidence to validate that it used relevant external benchmarks for either of these assessments.
Core element 57: Enterprise architecture products are continuously improved and updated.	Partial	Air Force officials provided information to demonstrate that enterprise architecture products are continuously improved and updated. For example, Air Force's configuration management plan outlines the process for making changes to the Air Force enterprise architecture as well as sample change requests and evidence that the requests have been approved and reflected in an updated version of the Air Force enterprise architecture. However, the department did not demonstrate that it has fully implemented its configuration management plan.
Core element 58: Enterprise architecture quality and results measurement methods are continuously improved.	No	Air Force did not demonstrate that it periodically reevaluates its methods for assessing enterprise-level and subordinate architecture quality and program results.
Core element 59: Enterprise architecture continuous improvement efforts reflect the results of external assessments.	Yes	Air Force demonstrated that its enterprise architecture continuous improvement efforts reflect the results of external assessments. For example, in our 2006 report on enterprise architecture management maturity, we reported that Air Force enterprise architecture products were not under configuration management. However, as described in element 57, the enterprise-level Air Force enterprise architecture is currently under configuration management.

Source: GAO analysis of information provided by Air Force.

Appendix IV: Department of the Army

The Department of the Army fully satisfied 7, partially satisfied 25, and did not satisfy 27 of the 59 elements described in our EAMMF. Table 11 summarizes the extent to which Army has addressed the core elements described in each stage of the EAMMF. Table 12 describes the extent to which the department satisfied each element.

Table 11: Army Satisfaction of Core Elements within Each Stage

Stage	Satisfied	Partially satisfied	Not satisfied
1	25	50	25
2	20	40	40
3	14	50	36
4	9	27	64
5	0	44	56
6	0	43	57
Average	12	42	46

Source: GAO analysis of information provided by Army.

Table 12: Army Satisfaction of EAMMF Core Elements

Core element	Satisfied?	Our analysis
Stage 1		
Core element 1: Written and approved organization policy exists for enterprise architecture development, maintenance, and use.	Yes	Army has written and approved policies that address enterprise architecture development, maintenance, and use. These policies identify the major players responsible for Army enterprise architecture efforts (e.g., the Army Chief Information Officer and the Army Chief Architect); define what an enterprise architecture includes (i.e., a baseline architecture, a target architecture, and a sequencing plan); and set direction on the use of enterprise architecture (e.g., eliminate unnecessary or redundant processes and reallocate resources).
Core element 2: Executive Committee representing the enterprise exists and is responsible and accountable for enterprise architecture.	Partial	Army has committees that are responsible and accountable for two of the department's three segment architectures. However, the department does not yet have an approved Executive Committee that represents the enterprise and is responsible and accountable for a departmentwide enterprise architecture. According to Army, a draft enterprise architecture policy will establish such a committee.
Core element 3: Executive Committee is taking proactive steps to address enterprise architecture cultural barriers.	Partial	Army has taken initial steps to address enterprise architecture cultural barriers by providing enterprise architecture overview briefings and plans to provide necessary resources to enterprise architecture activities. However, the department has not yet encouraged the disclosure and adoption of enterprise architecture shared services and promoted and rewarded enterprise architecture-related collaboration across organizational boundaries.

Core element	Satisfied?	Our analysis
Core element 4: Executive Committee members are trained in enterprise architecture principles and concepts.	No	According to Army officials, there is no formal enterprise architecture training that provides a basic understanding of enterprise architecture fundamentals and is appropriately tailored toward specific Executive Committee members or subordinate organizations.
Core element 5: Chief architect exists.	Yes	Army has appointed the Deputy Chief of Staff for Operations, Plans, and Training as the Army Chief Architect. The Chief Architect is responsible for, among other things, oversight and management of all Army architecture efforts.
Core element 6: Enterprise architecture purpose is clearly stated.	Partial	Army's Generating Force, Operating Force, and Network segments have defined purpose statements. However, these statements were not defined and approved by an enterprise-level Executive Committee.
Core element 7: Enterprise architecture framework(s) is adopted.	Partial	Army has adopted the Department of Defense Architecture Framework version 1.5 and is adopting version 2.0 as the basis for describing its enterprise architecture products. However, the suite of enterprise architecture products and artifacts to be developed, used, and maintained under the architecture framework version 2.0 has not been specified.
Core element 8: Enterprise architecture performance and accountability framework is established.	No	An enterprise architecture performance and accountability framework has not been established. Specifically, an enterprise-level approach for measuring enterprise architecture progress, management capacity, quality, use, and results has not been established. Further, although Army has identified the roles and responsibilities of key stakeholders, the specific metrics and means for ensuring that the roles and responsibilities are fulfilled and any deviations from expectations are not documented and disclosed.
Stage 2		
Core element 9: Enterprise architecture budgetary needs are justified and funded.	Partial	According to Army officials, funding requests for enterprise architecture needs are ad hoc and decentralized. While the architecture segments have received funding, their budgetary needs have not been fully met.
Core element 10: Enterprise architecture program office(s) exists.	Partial	Army has yet to establish a program office with responsibility for the department's enterprise architecture development and maintenance. According to Army officials, a draft regulation is being written and will assign responsibility for managing enterprise architecture. Existing subordinate program management offices are chartered and have responsibility for the Generating Force, Operating Force, and Network segment architectures.
Core element 11: Key program office leadership positions are filled.	Partial	Although Army has designated a Chief Architect, key program office leadership positions such as a configuration manager, risk manager, and quality assurance manager have not been identified and filled. While the Generating Force, Operating Force, and Network segment architectures have lead architects, key leadership positions for these segment architecture programs have not been filled.
Core element 12: Program office human capital plans exist.	No	Army does not have an enterprise architecture program office human capital plan. Specifically, Army has not identified the human capital needs and developed a plan for acquiring, developing, and retaining qualified staff with the requisite knowledge, skills, and abilities.
Core element 13: Enterprise architecture development and maintenance methodology exists.	No	The Army is drafting a regulation that calls for the development of an enterprise architecture methodology. However, the department has not yet documented a methodology that includes defined steps, tasks, standards, tools, techniques, and measures that govern how its enterprise architecture is to be developed, maintained, and validated.

Core element	Satisfied?	Our analysis
Core element 14: Automated enterprise architecture tools exist.	Yes	Army uses various automated tools to assist in capturing enterprise architecture information and developing, communicating, storing, and maintaining architecture products. For example, the department uses System Architect for the development of traditional enterprise architecture artifacts and a repository tool.
Core element 15: Enterprise architecture program management plan exists and reflects relationships with other management disciplines.	Partial	Army has not developed an enterprise architecture program management plan. However, the Network segment has developed a program management plan and an approach to developing its architecture that includes management structures, controls, and institutional management disciplines.
Core element 16: Work breakdown structure and schedule to develop enterprise architecture exist.	No	Army does not have a work breakdown structure to develop its enterprise architecture or architecture segments. Additionally, the department does not have a schedule to develop its enterprise architecture for two of the three architecture segments. While Army provided a high-level schedule for the Network architecture segment, the schedule does not define the timing, sequencing, and duration of program tasks, activities, and events.
Core element 17: Enterprise architecture segments, federation members, and/or extended members have been identified and prioritized.	Yes	Army has identified and prioritized three segment architectures: Generating Force, Operating Force, and Network in the Army Campaign Plan. Specifically, the first priority is the Operating Force segment with some support from the Generating Force and Network segments. The second priority is the Generating Force segment with some support from the Network segment. The third priority is the Network segment.
Core element 18: Program office readiness is measured and reported.	No	Army does not yet have an enterprise architecture program office. Further, the readiness of segment architecture program offices is not measured and reported. Specifically, the Army's people, processes, and tools elements have not been measured and have not been shared with the Executive Committee, Chief Architect, and subordinate architects.
Stage 3		
Core element 19: Organization business owner and CXO representatives are actively engaged in architecture development.	Partial	According to Army officials, organization business owners are assigned to segment architecture program offices. For example, Army officials stated that their General Officers (or equivalent) are actively involved with approving Army architecture development priorities and architecture products. However, Army has not yet established an enterprise-level architecture program office.
Core element 20: Enterprise architecture human capital plans are being implemented.	No	Army does not have an enterprise architecture human capital plan. Specifically, Army has not identified the human capital needs or developed a plan for acquiring, developing, and retaining qualified staff with the requisite knowledge, skills, and abilities.
Core element 21: Program office contractor support needs are being met.	No	According to Army officials, the segment architecture program office contractor support needs are not being met. Additionally, Army has not yet established an enterprise-level architecture office.
Core element 22: Program office staff are trained in enterprise architecture framework, methodology, and tools.	Partial	According to Army officials, enterprise architecture staff have attended architecture-related training. However, training needs are not identified in a human capital management plan.
Core element 23: Methodologies and tools exist to determine investment compliance with corporate and subordinate architectures.	Partial	According to Army officials, a methodology and tool exist and are used to determine business system investment compliance with its Generating Force segment architecture. However, automated tools and methodologies do not yet exist for non-business system investment compliance with the Operating Force and Network segment architectures.

Core element	Satisfied?	Our analysis
Core element 24: Methodologies and tools exist to determine subordinate architecture alignment with the corporate enterprise architecture.	No	Army does not have an enterprise-level architecture to which a methodology to determine subordinate architecture alignment can be applied.
Core element 25: Enterprise architecture-related risks are proactively identified, reported, and mitigated.	No	According to Army officials, the department does not have a formal set of risk management activities to proactively identify, report, and mitigate enterprise architecture-related risks. In addition, although the Army's Network segment architecture has a methodology that includes a risk management process, this process has yet to be implemented.
Core element 26: Initial versions of corporate "as-is" and "to-be" enterprise architecture and sequencing plan are being developed.	Partial	The department is developing segment architecture products that can be used to inform the development of an enterprise-level architecture. However, according to Army officials, enterprise-level architecture products have not yet been developed.
Core element 27: Initial version of corporate enterprise architecture describing the enterprise in terms of performance, business, data, services, technology, and security is being developed.	Partial	Army is developing segment architectures that begin to describe the enterprise segments in terms of performance, business, data, services, technology, and security. However, it has yet to develop an enterprise-level architecture that describes enterprise elements such as business rules and outcomes that all Army components are expected to adopt.
Core element 28: One or more segment and/or federation member architectures is being developed.	Yes	Army is developing segment architectures. For example, the department is developing architectures for its Generating Force and Network segments.
Core element 29: Architecture products are being developed according to the enterprise architecture content framework.	Partial	Army's segment architecture products are being developed in accordance with guidance such as the DOD architecture framework. However, a complete enterprise architecture framework has not yet been developed.
Core element 30: Architecture products are being developed according to a defined enterprise architecture methodology.	No	Army has established strategies for developing segment architecture products. However, a defined enterprise architecture methodology that includes steps, tasks, standards, tools, techniques, and measures to consistently develop enterprise-level architecture products has not yet been developed.
Core element 31: Architecture products are being developed using enterprise architecture tools.	Yes	Army is developing architecture products using the enterprise architecture tools described in element 14.
Core element 32: Architecture development progress is measured and reported.	Partial	Progress against plans is measured and reported for Army's Generating Force segment architecture, but not for Operating Force and Network segments. For example, the Office of Business Transformation produced a summary report that described the office's efforts for fiscal year 2010.
Stage 4		
Core element 33: Executive Committee has approved the initial version of corporate enterprise architecture.	No	Army does not have an enterprise-level architecture that has been approved by an executive committee.
Core element 34: Key stakeholders have approved the current version of subordinate architectures.	No	According to Army officials, key stakeholders, such as business owners and executive sponsors, have not approved all major releases of the department's subordinate architectures.

Core element	Satisfied?	Our analysis
Core element 35: Enterprise architecture is integral to the execution of other institutional management disciplines.	Yes	Segment architectures (Generating Force, Operating Force, and Network) are linked to the execution of other institutional management disciplines such as the Joint Capability Integration and Development System, Defense Acquisition System, and Planning, Programming, Budgeting, and Execution System.
Core element 36: Program office human capital needs are met.	No	Army does not have a basis for meeting the enterprise architecture human capital needs because it has not identified staffing requirements or gaps. Further, according to Army officials, they do not have sufficient staff to support their enterprise architecture program.
Core element 37: Initial versions of corporate “as-is” and “to-be” enterprise architecture and sequencing plan exist.	Partial	Army has developed initial versions of segment architecture products that can be used to inform the development of an enterprise-level architecture. For example, the department has developed initial versions of Army architectures for its Generating Force and Network segments. However, according to Army officials, enterprise-level architecture products have not yet been developed.
Core element 38: Initial version of corporate enterprise architecture captures performance, business, data, services, technology, and security views.	Partial	Army has developed initial versions of segment architecture products that can be used to inform the development of an enterprise-level architecture. For example, the initial version of its Network segment architecture begins to document its performance, business, data, services, technology, and security views. However, according to Army officials, the enterprise-level architecture has yet to be developed.
Core element 39: One or more segment and/or federation member architectures exists and is being implemented.	Partial	Army identified three segments, each with sub-segments. However, these segments have not been fully developed or implemented on a targeted or prioritized basis (see element 17). With respect to implementation, the department has used segment architecture artifacts to make decisions such as assessing data centers for closure or sustainment and consolidating data and enterprise e-mail.
Core element 40: Enterprise architecture product quality is measured and reported.	No	Army does not measure or report the quality of its enterprise architecture products. Although the Network architecture segment documentation states that quality control measures are to be used to determine quality, reuse, compliance, and risk, related measurements have not yet been defined. Further, according to Army officials, the quality of Generating Force and Operating Force architecture products is not measured and reported.
Core element 41: Enterprise architecture results and outcomes are measured and reported.	No	Army does not measure and report results and outcomes of its enterprise architecture efforts.
Core element 42: Investment compliance with corporate and subordinate architectures is measured and reported.	No	Measurement of investment compliance with Army enterprise-level architecture products does not occur because such products do not yet exist. Army officials did not provide sufficient documentation to support their position that investment compliance with subordinate architectures is measured and reported.
Core element 43: Subordinate architecture alignment with the corporate enterprise architecture is measured and reported.	No	Subordinate architecture alignment with the enterprise-level architecture is not measured and reported. Further, Army has not yet developed an enterprise-level architecture with which its subordinate architectures’ alignment could be measured and reported.
Stage 5		
Core element 44: Organization head has approved current version of the corporate enterprise architecture.	No	Army has not yet developed an enterprise-level architecture that would be approved by the Secretary of the Army.

Core element	Satisfied?	Our analysis
Core element 45: Organization component heads or segment owners have approved current version of their respective subordinate architectures.	Partial	According to Army, organization component heads or segment owners have approved the current version of the department's subordinate architectures. However, Army officials did not provide evidence that these approvals were based on quality measures.
Core element 46: Integrated repository tools and common enterprise architecture framework and methodology are used across the enterprise.	Partial	Generating Force architecture products are currently stored in a single repository; however, this repository does not include all Army architecture products. According to Army officials, Army plans to use a single repository tool for storing all architecture products. In addition, Army strategy calls for a common enterprise architecture framework and methodology to be used across the enterprise but this is not yet in place.
Core element 47: Corporate and subordinate architecture program offices operate as a single virtual office that shares resources enterprisewide.	No	Army has not yet established an enterprise-level architecture office and the department's subordinate architecture program offices do not operate as a single virtual office that shares resources.
Core element 48: Corporate enterprise architecture and sequencing plan are enterprisewide in scope.	Partial	According to Army officials, Army segments are enterprisewide in scope. In addition, Army has established a basis for developing enterprise-level architecture, such as the Army Operating Concept which describes the Army's mission and future operational environment. Further, Army has established a basis for developing an enterprise sequencing plan. For example, the Capabilities Set process describes concepts for prioritizing, integrating, and synchronizing activities across the Army.
Core element 49: Corporate enterprise architecture and sequencing plan are aligned with subordinate architectures.	No	Army has not developed an initial version of its enterprise-level architecture or sequencing plan, which would provide the basis for subordinate architecture alignment.
Core element 50: All segment and/or federated architectures exist and are horizontally and vertically integrated.	No	Army intends to horizontally and vertically integrate its architecture products. However, such integration has not yet occurred.
Core element 51: Corporate and subordinate architectures are extended to align with external partner architectures.	Partial	Army has begun to demonstrate that its architectures are extended to align with external partner architectures. For example, Army has demonstrated that its Generating Force segment is aligned with the DOD business enterprise architecture. However, the department has not demonstrated alignment with other external partner architectures (e.g., DON, Air Force).
Core element 52: Enterprise architecture products and management processes are subject to independent assessment.	No	Army's enterprise architecture products and management processes are not subject to independent assessment.
Stage 6		
Core element 53: Enterprise architecture is used by executive leadership to inform organization strategic planning and policy formulation.	Partial	According to Army officials, the segment architectures have been used to inform a key reference handbook for senior Army leaders. However, Army officials did not provide sufficient documentation to clearly link its architecture products with strategic plans and institutional policies.
Core element 54: Enterprise architecture human capital capabilities are continuously improved.	No	Army's enterprise architecture human capital capabilities are not continuously improved.
Core element 55: Enterprise architecture methodologies and tools are continuously improved.	Partial	According to Army officials, efforts to improve architecture tools are made but have been limited to the segment architectures, including the Generating Force and Operating Force segments. The officials stated that the department is drafting an enterprise architecture policy that will provide further guidance in this area.

Core element	Satisfied?	Our analysis
Core element 56: Enterprise architecture management processes are continuously improved and reflect the results of external assessments.	No	According to Army officials, the department has not subjected its enterprise architecture management processes to periodic reassessments by an entity that is external to the enterprise architecture program, such as the department's internal audit function or a contractor that is not responsible for any architecture development, maintenance, or management activities.
Core element 57: Enterprise architecture products are continuously improved and updated.	Partial	According to Army officials, the Generating Force and Operating Force segment enterprise architecture products have been improved and updated to reflect events such as changes in legal requirements. However, Army's Network segment architecture officials reported that its enterprise architecture products are not continuously improved and updated; and the Army does not yet have a formal configuration management process for ongoing architecture maintenance.
Core element 58: Enterprise architecture quality and results measurement methods are continuously improved.	No	According to Army officials, enterprise architecture quality and results measurement methods are not continuously improved.
Core element 59: Enterprise architecture continuous improvement efforts reflect the results of external assessments.	No	According to Army officials, enterprise architecture continuous improvement efforts do not reflect the results of external assessments.

Source: GAO analysis of information provided by Army.

Appendix V: Department of the Navy

The Department of the Navy (DON) fully satisfied 16, partially satisfied 24, and did not satisfy 19 of the 59 elements described in our EAMMF. Table 13 summarizes the extent to which DON has addressed the core elements described in each stage of the EAMMF. Table 14 describes the extent to which the department satisfied each element.

Table 13: DON Satisfaction of Core Elements within Each Stage

Stage	Satisfied	Partially satisfied	Not satisfied
1	50	38	13
2	20	50	30
3	36	36	29
4	27	36	36
5	11	44	44
6	14	43	43
Average	27	41	32

Source: GAO analysis of information provided by DON.

Table 14: DON Satisfaction of GAO EAMMF Core Elements

Core element	Satisfied?	Our analysis
Stage 1		
Core element 1: Written and approved organization policy exists for enterprise architecture development, maintenance, and use.	Yes	DON has written and approved policies, approved by the head of the department that address enterprise architecture development, maintenance, and use. These policies identify the major players responsible for DON's enterprise architecture efforts, (e.g., the DON CIO and DON Chief Architect); define what the enterprise architecture must include (i.e., the current architecture, target architecture, and a plan to transition to the desired state); and set direction on the use of enterprise architecture (e.g., promotion of interoperability, public access, and IT security).
Core element 2: Executive Committee representing the enterprise exists and is responsible and accountable for enterprise architecture.	Yes	DON has assigned responsibility and accountability for directing, overseeing, and approving its architecture to a formally chartered executive committee named the Information Enterprise Governance Board (IGB). It includes representatives from across the organization's units, such as research, development, and acquisition; financial management; energy and the environment; manpower; and cyber command.
Core element 3: Executive Committee is taking proactive steps to address enterprise architecture cultural barriers.	Yes	DON is taking steps to address enterprise architecture cultural barriers, as evidenced by the recent establishment of the IGB with the intent of increasing participation and support for the department's enterprise architecture among senior-level staff; the department's plans to provide training to the acquisition community on the value of enterprise architecture; and plans to develop a road map to address the lack of a common understanding among stakeholders on how enterprise architecture relates to department plans and goals.

Core element	Satisfied?	Our analysis
Core element 4: Executive Committee members are trained in enterprise architecture principles and concepts.	Partial	DON offers training on basic enterprise architecture fundamentals, such as DON's enterprise architecture content and framework, at various Navy and Marine Corps locations and this training is available to IGB members. However, this training is not mandatory for members of the IGB. According to officials, members of the committee are assumed to have the knowledge and experience needed to understand the department's enterprise architecture at an appropriate level of granularity without attending training sessions.
Core element 5: Chief architect exists.	Yes	As the DON chief architect, the CIO leads the enterprise-level architecture program and is responsible for enterprise architecture development and maintenance. The chief architect is also accountable to the IGB and has experience in the IT and business sides of the organization.
Core element 6: Enterprise architecture purpose is clearly stated.	Partial	DON has defined the purpose for its enterprise architecture, which is communicated to the stakeholders in key documents, such as training packages. In addition, the purpose is written to support DON's goals and objectives. However, although the purpose was approved by executive-level officials such as the CIO, it has not yet been approved by the IGB, which includes representatives from across the organization's units. According to officials, the IGB will approve future versions of the enterprise architecture purpose. However, this responsibility has yet to be formally documented.
Core element 7: Enterprise architecture framework(s) is adopted.	Partial	DON has developed a version of an enterprise architecture framework. However the framework has yet to define the complete suite of enterprise architecture products and artifacts to be developed or the relationships between them. Further, according to DON documentation, the framework is not yet sufficiently flexible to serve the needs of a large and diverse organization such as DON.
Core element 8: Enterprise architecture performance and accountability framework is established.	No	Although the March 2011 enterprise architecture Executive Committee charter calls for its members to develop metrics and feedback measures for evaluating the effectiveness of key stakeholders (e.g., DON Deputy CIO (Navy), DON Deputy CIO (Marine Corps), and the DON CIO) in achieving IT goals, DON officials stated that an enterprisewide enterprise architecture performance and accountability framework has yet to be established.
Stage 2		
Core element 9: Enterprise architecture budgetary needs are justified and funded.	Partial	According to DON officials, although sufficient budgetary resources to establish and execute its enterprise architecture program are not available due to the current fiscally constrained environment, they have been able to maintain a small team of government and contractor staff for the program, which has allowed them to achieve several milestones and begin to develop and use some architecture artifacts. Officials acknowledged, however, that stabilizing and using the current DON enterprise architecture has been prioritized over developing additional enterprise architecture content since sufficient resources are not available for both activities. Officials also stated that the level of funding needed to satisfy enterprise architecture budgetary needs has not been identified and justified through reliable cost estimating and expected program benefits. Rather, architecture activities are funded out of individual stakeholder and program budgets, and funding levels are discretionary.

Core element	Satisfied?	Our analysis
Core element 10: Enterprise architecture program office(s) exists.	Partial	DON has established a small, dedicated team within the CIO's office to perform activities that are typically associated with a program office. For example, specific team members are responsible for configuration management, program planning, performance monitoring, and project status reporting to the department's enterprise architecture Executive Committee. However, according to officials, the department has no plans to establish a formally chartered enterprise-level architecture program management office. Officials stated that it is difficult to justify the creation of a large enterprise architecture program office in a fiscally constrained environment.
Core element 11: Key program office leadership positions are filled.	Yes	Although DON has not established a formally chartered enterprise architecture program office, key enterprise architecture leadership roles are being performed such as the enterprise architecture Project Manager, Senior Technical Architect, and the Release Agent responsible for enterprise architecture configuration management. Additionally, key enterprise architecture governance groups have been established to support the Chief Architect, such as the Enterprise Architecture Working Group, to assist in developing enterprise architecture artifacts, the Independent Verification and Validation Working Group to assess enterprise architecture artifact quality, and the Configuration Control Board to approve changes to enterprise architecture artifacts.
Core element 12: Program office human capital plans exist.	No	According to DON officials, enterprise architecture program staff are not hired according to a human capital plan that would identify the knowledge, skills, and abilities that are needed for the enterprise architecture program as well as the approach for addressing any gaps in training, developing, and retaining existing staff or hiring new staff.
Core element 13: Enterprise architecture development and maintenance methodology exists.	Partial	Although officials demonstrated that elements of an enterprise architecture development and maintenance methodology can be found in existing enterprise architecture program documents, they acknowledged that a comprehensive methodology that includes defined steps, tasks, standards, tools, techniques, and measures that govern how the architecture is to be developed, maintained, and validated has yet to be developed. Officials indicated that there are no specific time frames for when a DON enterprise architecture methodology will be developed. According to DON officials, this is due to the department's focus on other resource-intensive commitments, such as applying the current enterprise architecture content.
Core element 14: Automated enterprise architecture tools exist.	Yes	DON uses various automated enterprise architecture tools to capture information described by its enterprise architecture framework and to develop, communicate, store, and maintain architecture products. For example, the department uses System Architect for the development of traditional enterprise architecture artifacts and an IT portfolio registry for assessing architecture compliance assertions and waiver requests.
Core element 15: Enterprise architecture program management plan exists and reflects relationships with other management disciplines.	Partial	Although a DON enterprise architecture governance plan is in place that defines enterprise architecture management structures and the roles and responsibilities of stakeholders, a comprehensive plan for managing the DON enterprise architecture program that defines the major enterprise architecture releases to be developed and addresses key enterprise architecture management areas such as human capital management, risk management, and information security management has yet to be developed. According to officials, an overarching road map is in development that will act as the enterprise architecture program management plan until a more detailed plan is developed. In the absence of a plan, officials stated that enterprise architecture activities are informally managed by, for example, discussing program priorities with subject matter experts.

Core element	Satisfied?	Our analysis
Core element 16: Work breakdown structure and schedule to develop enterprise architecture exist.	No	DON does not currently have a work breakdown structure that decomposes the specific tasks, activities, and events needed to execute the department's enterprise architecture program, and a reliable schedule that defines the timing, sequencing, and duration of the tasks, activities, and events. According to DON officials, the overarching road map in development that will act as the enterprise architecture program management plan will also identify enterprise architecture program milestones. Officials also stated that detailed work breakdown structures are expected to be developed at a future date to support the achievement of the milestones.
Core element 17: Enterprise architecture segments, federation members, and/or extended members have been identified and prioritized.	Partial	According to DON officials and draft documentation, nine enterprise architecture segment reference architectures have been identified, of which three have been prioritized for initial development. However, the identification and prioritization of these segments have yet to be approved by the Executive Committee. According to officials, the identification and prioritization will be discussed with the executive committee once the enterprise architecture road map is relatively mature.
Core element 18: Program office readiness is measured and reported.	No	DON has not chartered an office to manage its enterprise architecture program. Thus, the department has yet to measure the extent to which people, processes, and tools enablers have been put in place and report this readiness information to the enterprise architecture Executive Committee and Chief Architect.
Stage 3		
Core element 19: Organization business owner and CXO representatives are actively engaged in architecture development.	Yes	According to documentation, executive-level members, such as the DON CIO, Chief Architect, Deputy CIOs for the Navy and Marine Corps, and the Deputy Chief Management Officer, are actively engaged in developing enterprise architecture products with enterprise architecture program staff.
Core element 20: Enterprise architecture human capital plans are being implemented.	No	DON has yet to develop a human capital plan that identifies the knowledge, skills, and abilities that are needed for the enterprise architecture program as well as the approach for addressing any gaps in training, developing, and retaining existing staff or hiring new staff.
Core element 21: Program office contractor support needs are being met.	Partial	According to officials, the enterprise architecture program is supported by two full-time contractor support staff. Officials noted that they consider this to be reasonable considering the current fiscally constrained environment. However, a human capital plan is not in place to ensure that the appropriate degrees of contractor expertise, skills, and competencies are acquired and assimilated into the program office.
Core element 22: Program office staff are trained in enterprise architecture framework, methodology, and tools.	Partial	According to DON officials, enterprise architecture training is targeted to the expected audience and available for program staff at conferences or training sessions provided at various Navy and Marine Corps locations; however, attendance is not mandatory. The enterprise architecture training package provides a basic understanding of enterprise architecture fundamentals, including enterprise architecture content, the enterprise architecture framework, enterprise architecture governance, and enterprise architecture compliance assertions and review processes.

Core element	Satisfied?	Our analysis
Core element 23: Methodologies and tools exist to determine investment compliance with corporate and subordinate architectures.	Yes	DON has developed methodologies and tools to determine investment compliance with the department's enterprise architecture. Specifically, in October 2009, the department released an updated version of its Investment Review Process Guidance that describes the process for assessing investment compliance with the enterprise-level architecture on an annual basis. The methodology provides for exceptions to architecture compliance on the basis of analytical justifications that are (1) captured in documented enterprise architecture waivers and (2) used to update the enterprise architecture. In addition, according to the guide and officials, the enterprise architecture compliance and waiver processes are fully automated in the department's variant of the Department of Defense's Information Technology Portfolio Repository tool.
Core element 24: Methodologies and tools exist to determine subordinate architecture alignment with the corporate enterprise architecture.	Partial	According to officials, the results of subordinate architecture alignment assessments with the enterprise-level architecture can be captured in the Department of Defense's Information Technology Portfolio Repository tool; however, officials stated that a methodology does not yet exist for developing segment reference architectures and will need to be developed at some future date. The officials also stated that the methodology would include specific processes, procedures, and guidelines in order to ensure that subordinate architectures are aligned to the enterprise-level architecture and that the verification of alignment is expected to be conducted by DON's enterprise architecture Independent Verification & Validation Working Group.
Core element 25: Enterprise architecture-related risks are proactively identified, reported, and mitigated.	No	According to officials, enterprise architecture program risk management activities are informally conducted and not explicitly aligned with a risk management process. DON officials stated that in addition to acting as the enterprise architecture program management plan, work breakdown structure, and schedule, a road map document is being developed to address enterprise architecture risk management activities.
Core element 26: Initial versions of corporate "as-is" and "to-be" enterprise architecture and sequencing plan are being developed.	Partial	Initial versions of the enterprise-level architecture are being developed. However, the department does not expect to document separate current and target architectures. Further, while the department has developed a business architecture transition plan, it does not intend to develop an enterprisewide transition plan.
Core element 27: Initial version of corporate enterprise architecture describing the enterprise in terms of performance, business, data, services, technology, and security is being developed.	Yes	Initial versions of the enterprise architecture describe the enterprise in terms of business, data, services, technology, and security. For example, it identifies reference models for business, data, services, technology, and security.
Core element 28: One or more segment and/or federation member architectures is being developed.	Yes	One or more segment and/or federation member architectures is being developed. For example, the department has developed artifacts for its Net Centric segment architecture.
Core element 29: Architecture products are being developed according to the enterprise architecture content framework.	Partial	Architecture products are being developed according to guidelines. However, the enterprise architecture framework has yet to define the complete suite of enterprise architecture products and artifacts to be developed or the relationships between them.
Core element 30: Architecture products are being developed according to a defined enterprise architecture methodology.	No	While the department does not currently have a defined enterprise architecture methodology, it is developing a road map for developing such a methodology.

Core element	Satisfied?	Our analysis
Core element 31: Architecture products are being developed using enterprise architecture tools.	Yes	DON is developing architecture products using the enterprise architecture tools described in element 14.
Core element 32: Architecture development progress is measured and reported.	No	According to officials, the department does not currently have the necessary documents in place for measuring and reporting on architecture development progress. Specifically, as stated, the department has yet to develop an enterprise architecture program plan, work breakdown structure, and schedule, as well as their associated costs; as a result, the department's progress in executing tasks defined in such documents cannot be measured.
Stage 4		
Core element 33: Executive Committee has approved the initial version of corporate enterprise architecture.	Partial	The current DON enterprise architecture has been approved by the department's Enterprise Architecture Approval Board, which is chaired by the department's CIO. However, the enterprise architecture has not been approved by the department's enterprise architecture executive committee that was established in March 2011. While the committee has agreed to approve future versions of the enterprise architecture, it has not yet done so.
Core element 34: Key stakeholders have approved the current version of subordinate architectures.	No	According to officials, nine segment reference architectures have been identified, of which three have been prioritized for initial development. However, the core teams with subject matter experts have not yet been formed and key leadership positions, including lead architects, have not been designated to develop these segments. Officials also stated that the review and approval of subordinate architectures will likely follow existing procedures, with the IGB providing the final approval.
Core element 35: Enterprise architecture is integral to the execution of other institutional management disciplines.	Yes	The DON enterprise architecture is linked to the execution of the department's strategic planning, capital planning and investment control, and system development and acquisition management. For example, the enterprise architecture is identified as a mechanism for achieving strategic goals and objectives. In addition, assessments of enterprise architecture compliance are conducted during annual reviews of the department's IT investments and modernization efforts.
Core element 36: Program office human capital needs are met.	No	According to officials and documentation, the department has qualified but minimal staff that perform enterprise architecture functions. However, officials stated that more staff are needed and program resources do not allow for additional hiring. In addition, as stated, the department has yet to develop a human capital plan that would identify the knowledge, skills, and abilities needed to execute the department's enterprise architecture program plans and schedules.
Core element 37: Initial versions of corporate "as-is" and "to-be" enterprise architecture and sequencing plan exist.	Partial	DON has developed initial versions of enterprise-level architecture focused on a small set of artifacts based on existing laws, regulations, policy, and guidance. However, the department's enterprise architecture does not distinguish between current and target products. DON also has developed a business transition plan that identifies legacy business systems, migration systems, and core systems. However, it has not developed an initial version of an enterprise-level sequencing plan.
Core element 38: Initial version of corporate enterprise architecture captures performance, business, data, services, technology, and security views.	Partial	DON's initial version of its enterprise-level architecture captures aspects of business, data, services, technology, and security. However, it does not address performance.

Core element	Satisfied?	Our analysis
Core element 39: One or more segment and/or federation member architectures exists and is being implemented.	Partial	DON has developed segment architecture products. For example, the department has developed segment architecture products for its Net Centric architecture. However, it has not completed the development of any segment architectures. In addition, the department did not provide evidence that segment architectures are being implemented.
Core element 40: Enterprise architecture product quality is measured and reported.	Yes	The quality of DON's enterprise architecture products is assessed by the Independent Verification and Validation Working Group in accordance with a set of criteria and submitted for final approval to the DON Enterprise Architecture Approval Board.
Core element 41: Enterprise architecture results and outcomes are measured and reported.	No	DON has yet to measure and report enterprise architecture results and outcomes. Officials stated that a lack of best practices for measuring the value of enterprise architecture has inhibited the department's ability to demonstrate return on investment to enterprise-level executives.
Core element 42: Investment compliance with corporate and subordinate architectures is measured and reported.	Yes	DON provided evidence showing that compliance assessments with its enterprise architecture are measured against criteria described in the IT investment management process. Final approval decisions are made by the DON CIO or Deputy CIOs and placed in the system inventory. According to officials, compliance metrics are reported to appropriate executive-level staff and available for review in the Department of Defense's Information Technology Portfolio Repository.
Core element 43: Subordinate architecture alignment with the corporate enterprise architecture is measured and reported.	No	According to officials, core teams will be established to develop segment reference architectures. A responsibility of these teams will be to produce metrics for measuring segment alignment with the enterprise-level architecture. However, officials stated that metrics for measuring and reporting alignment are currently not in place.
Stage 5		
Core element 44: Organization head has approved current version of the corporate enterprise architecture.	Yes	The DON CIO has approved and released the current version of the department's enterprise architecture. The CIO was delegated responsibility for overseeing the development and maintenance of the department's architecture in policy issued by the Secretary of the Navy.
Core element 45: Organization component heads or segment owners have approved current version of their respective subordinate architectures.	No	According to officials, a small number of segment architecture artifacts are currently in place. These artifacts were assessed against quality measures, submitted for approval, and released in the same manner as the DON enterprise-level architecture. However, officials stated that the enterprise architecture program is not yet at a level where versions of the segment architectures have been developed and approved.
Core element 46: Integrated repository tools and common enterprise architecture framework and methodology are used across the enterprise.	Partial	DON has a portal that serves as a common repository for its enterprise architecture products. However, DON has not fully established a common enterprise architecture framework or methodology to define how architectural products will be developed across the enterprise.
Core element 47: Corporate and subordinate architecture program offices operate as a single virtual office that shares resources enterprisewide.	No	DON has not established a formal enterprise-level architecture program office and subordinate architecture program offices; therefore, entities are not in place that could operate as a single virtual office that shares limited resources and follows common policies and procedures.
Core element 48: Corporate enterprise architecture and sequencing plan are enterprisewide in scope.	Partial	DON's enterprise-level architecture is enterprisewide in scope. However, DON has not developed an enterprise-level sequencing plan.

Core element	Satisfied?	Our analysis
Core element 49: Corporate enterprise architecture and sequencing plan are aligned with subordinate architectures.	Partial	DON has begun to demonstrate that it has aligned its enterprise architecture with its segment reference architectures. For example, it has aligned subordinate operational activities with its enterprise architecture capabilities. However, the department does not have subordinate architectures for some segments. In addition, not all segment architecture products are aligned with the enterprise-level architecture. Moreover, it has yet to develop its enterprise sequencing plan.
Core element 50: All segment and/or federated architectures exist and are horizontally and vertically integrated.	No	DON has not developed all segment and/or federated architectures. In addition, it has yet to provide evidence that segment and/or federated architectures are horizontally and vertically integrated.
Core element 51: Corporate and subordinate architectures are extended to align with external partner architectures.	Partial	DON has begun to demonstrate that its enterprise-level and subordinate architectures are extended to align with external partner architectures. For example, its enterprise architecture approach is aligned with the Joint Staff's Joint Capability Areas. However, DON did not provide evidence that its enterprise architecture aligns with other external partner architectures (e.g., Army, Air Force).
Core element 52: Enterprise architecture products and management processes are subject to independent assessment.	No	While enterprise architecture products have undergone verification and validation assessments, they were not conducted by an independent body. Moreover, enterprise architecture management processes have not been subject to independent verification and validation.
Stage 6		
Core element 53: Enterprise architecture is used by executive leadership to inform organization strategic planning and policy formulation.	Partial	DON officials demonstrated that the enterprise architecture is informing an update to a department policy to ensure that open source software requirements are adequately addressed. Officials stated that the department's strategic plan is being updated and will identify the department's enterprise architecture as a mechanism for achieving each of the department's goals and objectives. However, the updated strategic plan was not available for review in order to verify the department's assertions.
Core element 54: Enterprise architecture human capital capabilities are continuously improved.	No	DON does not have a human capital plan in place that identifies the enterprise architecture human capital capabilities that are needed as well as an approach for addressing capability gaps. Thus, the department currently lacks a foundational document that is needed for continuous improvement of enterprise architecture human capital capabilities.
Core element 55: Enterprise architecture methodologies and tools are continuously improved.	Partial	DON has automated enterprise architecture tools in place but has not established an enterprise architecture development and maintenance methodology. According to officials, regular reviews and improvements are made to the department's enterprise architecture tools that are generally based on lessons learned from using the architecture as well as yearly reviews of the department's systems.
Core element 56: Enterprise architecture management processes are continuously improved and reflect the results of external assessments.	No	DON has yet to subject its enterprise architecture management processes to periodic reassessments against relevant benchmarks and guidance and identify the gaps that need to be addressed.

Core element	Satisfied?	Our analysis
Core element 57: Enterprise architecture products are continuously improved and updated.	Partial	According to officials, the department's enterprise architecture products have been improved, updated, and released as new versions to reflect events such as changes in legal requirements, emerging technologies, and governmentwide priorities. DON has also developed a formal configuration management plan that includes a change control process; however, a process has not been formalized for conducting configuration audits and reviews to ensure that only approved changes are made to products and to maintain the integrity of the configuration baselines.
Core element 58: Enterprise architecture quality and results measurement methods are continuously improved.	No	According to officials, the department is in the early stages of developing metrics to measure enterprise architecture quality and results and has yet to measure and report enterprise architecture results and outcomes.
Core element 59: Enterprise architecture continuous improvement efforts reflect the results of external assessments.	Yes	Our 2008 assessment of the department's enterprise architecture program has been leveraged to make program capability and product improvements. Areas in which DON's improvement efforts reflect the results of our assessment include establishing a formalized enterprise architecture governance structure, a policy for enterprise architecture development and maintenance, an IT investment process that includes compliance assessments with DON's architecture, and a set of criteria for measuring the quality of its products.

Source: GAO analysis of information provided by the DON.

Appendix VI: Comments from the Department of Defense

DEPARTMENT OF DEFENSE
6000 DEFENSE PENTAGON
WASHINGTON, D.C. 20301-6000

SEP 13 2011

Ms. Valerie C. Melvin
Director, Information Management and Human Capital Issues
U.S. Government Accountability Office
441 G Street, N.W.
Washington, DC 20548

Dear Ms. Melvin:

This is the Department of Defense (DoD) response to the GAO Draft Report, GAO-11-902, 'ORGANIZATIONAL TRANSFORMATION: Military Departments Can Improve Their Enterprise Architecture Programs,' dated August 22, 2011 (GAO Code 310956).

The Department appreciates the opportunity to comment. We partially concur with GAO recommendation. Our rationale for our partial concurrence is provided.

Teresa M. Takai

Attachments:
As stated

GAO DRAFT REPORT DATED AUGUST 22, 2011
GAO-11-902 (GAO CODE 310956)

"ORGANIZATIONAL TRANSFORMATION: MILITARY DEPARTMENTS CAN IMPROVE THEIR ENTERPRISE ARCHITECTURE PROGRAMS"

DEPARTMENT OF DEFENSE COMMENTS TO THE GAO RECOMMENDATIONS

RECOMMENDATION: To ensure that the military departments establish commitments to fully develop and effectively manage their enterprise architectures, GAO recommends that the Secretaries of the Air Force, Army, and Navy each expeditiously provide to the congressional defense committees a plan that identifies milestones for their respective department's full satisfaction of all of GAO's Enterprise Architecture Management Maturity Framework elements. In the event that a military department does not intend to fully satisfy all elements of GAO's framework, the plan should include a rationale for why the military department deems any such element(s) to be not applicable.

DoD RESPONSE: The Department of Defense partially concurs with this recommendation. The Department of Defense Chief Information Officer and the Department of the Army Chief Information Officer concur with the recommendation. The Department of the Air Force (USAF) Chief Information Officer and Department of the Navy (DON) Chief Information Officer non-concur. Both the USAF and the DON believe that the GAO's Enterprise Architecture Management Maturity Framework (EAMMF) provides a very comprehensive set of elements associated with the development and implementation of a robust enterprise architecture program for a Federal Agency or Organization. Both the USAF and the DON, however, do not have a valid business case that would justify the implementation of all 59 elements of the EAMMF. In today's fiscally constrained environment, both have chosen to gradually implement selected elements of the EAMMF which are most useful in implementing optimized, secure, and cost effective Information Technology systems and capabilities.

Appendix VII: GAO Contact and Staff Acknowledgments

GAO Contact

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Staff Acknowledgments

In addition to the contact named above, Neelaxi Lakhmani and Mark Bird, Assistant Directors; Debra Conner; Shaun Byrnes; Elena Epps; Nancy Glover; Michael Holland; Anh Le; Lee McCracken; and Donald Sebers made key contributions to this report.

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