



Testimony

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INFORMATION TECHNOLOGY

The Federal Enterprise Architecture and Agencies' Enterprise Architectures Are Still Maturing

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Highlights of [GAO-04-798T](#), a testimony before the Subcommittee on Technology, Information Policy, Intergovernmental Relations and the Census, Committee on Government Reform, House of Representatives.

Why GAO Did This Study

The concept of enterprise architecture emerged in the mid-1980s as a means for optimizing integration and interoperability across organizations. In the early 1990s, GAO research of successful public and private sector organizations led it to identify enterprise architecture as a critical success factor for agencies that are attempting to modernize their information technology (IT) environments. Since then, GAO has repeatedly identified the lack of an enterprise architecture as a key management weakness in major modernization programs at a number of federal agencies. It has also collaborated with the Office of Management and Budget (OMB) and the federal Chief Information Officers (CIO) Council to develop architecture guidance. In 2002, OMB began developing the Federal Enterprise Architecture (FEA), an initiative intended to guide and constrain federal agencies' enterprise architectures and IT investments.

GAO was asked to testify on the status of the FEA and on the state of federal agencies' development and use of enterprise architectures.

www.gao.gov/cgi-bin/getrpt?GAO-04-798T.

To view the full product, including the scope and methodology, click on the link above. For more information, contact Randy Hite at 202-512-6256 or hiter@gao.gov.

INFORMATION TECHNOLOGY

The Federal Enterprise Architecture and Agencies' Enterprise Architectures Are Still Maturing

What GAO Found

OMB has made progress on the FEA, but it remains very much a work in process and is still maturing. Its stated purposes include facilitating (1) the development of agencies' enterprise architectures, (2) the reuse of common IT components across agencies, and (3) the identification of opportunities for interagency collaboration in developing common IT solutions. Currently, the FEA is made up of five parts known as reference models, four of which have been issued in at least initial form (see table). OMB reports that the FEA has been used to help identify potentially redundant agency IT investments, choose five lines of business (e.g., grants management) in which to pursue opportunities for agency collaboration, and begin to develop the architectural foundation for some of these business lines. GAO supports the FEA as a framework for achieving these ends, but raises questions whose answers are important to its future. For example: Should the FEA be described as an enterprise architecture? GAO's reading of its content suggests that it is more akin to a classification scheme for government operations than a true enterprise architecture. Further, OMB requires agencies to "map" and "align" their architectures with the FEA. However, since these terms are not well-defined, GAO asks if the expected relationship between the FEA and agencies' architectures is clear enough.

Like the FEA, agencies' enterprise architectures are still maturing. GAO recently reported ([GAO-04-40](#)) that agencies' management of architecture programs was generally not mature. Using its Enterprise Architecture Management Maturity Framework as a benchmark, GAO found little change in overall maturity between 2001 and 2003. Only 20 of 96 agencies examined had established at least the foundation for effective architecture management. Further, while 22 agencies increased in maturity since 2001, 24 agencies decreased and 47 agencies remained the same. Recently, OMB and the federal CIO Council initiated actions to advance agency architecture programs that are consistent with many of GAO's recommendations.

FEA Reference Models

Reference model	Description	Release date
Performance	Provides a common set of general performance outputs and measures for agencies to use to achieve business goals and objectives.	V 1.0, September 2003
Business	Describes the hierarchy of federal business operations independent of the agencies that perform them, including defining the services provided to state and local governments.	V 2.0, June 2003
Service component	Identifies and classifies IT service (i.e., application) components that support federal business operations and promotes the reuse of components across agencies	V 1.0, June 2003
Data and information	Is intended to describe, at an aggregate level, the types of data and information that support program and business line operation and the hierarchical relationships among them.	Planned for 2004
Technical	Describes how technology is supporting the delivery of service components, including relevant implementation standards.	V 1.1, August 2003

Source: GAO analysis of OMB data.

Mr. Chairman and Members of the Subcommittee:

I appreciate the opportunity to participate in the Subcommittee's hearing on the status of the Federal Enterprise Architecture (FEA) and on the state of federal agencies' development and use of enterprise architectures—two topics that are closely related.

An enterprise architecture can be viewed as a link between an organization's strategic plan and the program and supporting system implementation investments that it intends to pursue to systematically achieve its strategic goals and outcomes. As such, the architecture is basically a blueprint, defined largely by interrelated models, that describes (in both business and technology terms) an entity's "as is" or current environment, its "to be" or future environment, and its investment plan for transitioning from the current to the future environment. The use of such a blueprint is a recognized hallmark of organizations that effectively leverage technology in the transformation and modernization of business operations and supporting systems. Further, it is recognized in legislation and related Office of Management and Budget (OMB) implementing guidance. The FEA is intended to provide a governmentwide framework to guide and constrain federal agencies' enterprise architectures and information technology (IT) investments.

My testimony today is drawn largely from our 2003 report on federal agencies' development and use of enterprise architectures, which was based on work conducted in accordance with generally accepted government auditing standards.¹ We augmented the results in this report with available information on the recent actions of OMB and the federal Chief Information Officers (CIO) Council to address the recommendations that we made in the report. This testimony is also based on discussions with and information from

¹ U.S. General Accounting Office, *Information Technology: Leadership Remains Key to Agencies Making Progress on Enterprise Architecture Efforts*, GAO-04-40 (Washington, D.C.: Nov. 17, 2003).

OMB on the FEA, as well as discussions with GAO's Executive Council on Information Management and Technology.²

Results in Brief

The FEA continues to evolve in both content and use, which is both reasonable and expected, in our view, for such a broad-based framework. Through the FEA, OMB is attempting to provide federal agencies and other decision-makers with a common frame of reference or taxonomy for informing agencies' individual enterprise architecture efforts and their planned and ongoing investment activities, and to do so in a way that identifies opportunities for avoiding duplication of effort and launching initiatives to establish and implement common, reusable, and interoperable solutions across agency boundaries. We support this goal, and the development and use of the FEA as part of the means to accomplish it. We nevertheless observe that development and use of the FEA is but the first step in a multistep process needed to realize the promise of such interagency solutions. Because the FEA is still maturing both in content and in use, we have a number of questions that we believe OMB needs to address to maximize understanding about the tool and thus facilitate its advancement.

1. Should the FEA be described as an enterprise architecture?
2. Is the expected relationship between agencies' enterprise architectures and the FEA clearly articulated?
3. How will the security aspects of the FEA be addressed?

Like the FEA, the enterprise architecture efforts of individual federal departments and agencies are also still maturing. In September 2003, we reported that federal agencies' collective

² GAO's Executive Council on Information Management and Technology is composed of senior level officials from the public sector, private sector, and academia. Members include former CIOs for government agencies, professors of information technology, presidents of private businesses, and information technology consultants.

progress toward effectively managing enterprise architectures was limited, with much work remaining.³ In particular, the percentage of agencies that had established at least the foundation for effective enterprise architecture management was virtually unchanged from where it was in 2001 (about 50 percent). We further reported that when the state of enterprise architecture is considered in relation to a more recent and demanding benchmark, this percentage dropped to about 20 percent (in round terms), although some agencies did do well against this benchmark and were thus role models for other agencies to follow. This composite picture of immature enterprise architecture management can be attributed to several long-standing challenges, which were the basis for the recommendations that we made to OMB in 2001 and reiterated in 2003. Recently, OMB and the CIO Council took steps that are consistent with many of our recommendations. We support these steps, and we are working collaboratively with both organizations to maximize their effectiveness. However, the fact remains that until agencies have and use well-defined enterprise architectures, they will be severely challenged in their ability to effectively leverage IT in transforming their operations.

Background

The concept of using an architecture to describe an enterprise emerged in the mid-1980s, and over the years, the field of enterprise architecture has continued to evolve and mature. In the early 1990s, we identified an architecture as a critical success factor in allowing organizations to effectively apply IT to meet mission goals. Since then, we have worked with the Congress, OMB, and the CIO Council to promote the importance of architectures and assist agencies in developing, maintaining, and using them. In our reviews of selected agency IT management practices and major systems modernization programs, we have consistently identified the lack of an architecture as a major management weakness and made recommendations to address this important area.

³ [GAO-04-40](#).

To help oversee and budget for federal IT investments, OMB began developing the FEA in 2002, and has since issued versions of four of its five major parts. According to OMB, the FEA is to provide a common, governmentwide framework for agency enterprise architectures and IT investments. Thus far, OMB reports that it has begun using the FEA to identify and address interagency duplication of effort and to launch interagency projects.

What Is an Enterprise Architecture?

In simplest terms, an enterprise is any purposeful activity, and an architecture is the structural description of an activity. Building on this, we can view enterprise architectures as systematically derived and captured structural descriptions—in useful models, diagrams, and narrative—of the mode of operation for a given enterprise, which can be either a single organization or a functional or mission area that transcends more than one organizational boundary (e.g., financial management, homeland security).

The architecture can also be viewed as a blueprint that links an enterprise's strategic plan to the programs and supporting systems that it intends to implement to accomplish the mission goals and objectives laid out in the strategic plan. As such, the architecture describes the enterprise's operations in both logical terms (such as interrelated business processes and business rules, information needs and flows, and work locations and users) and technical terms (such as hardware, software, data, communications, and security attributes and performance standards). Moreover, it provides these perspectives both for the enterprise's current (or "as-is") environment and for its targeted future (or "to-be") environment, as well as for the transition plan for moving from the "as-is" to the "to-be" environment.

Importance of Enterprise Architectures

The importance of enterprise architectures is a basic tenet of 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 goal: that is, agency operational structures that are optimally defined, in terms of both business and

technology. The alternative, as our work has shown, is perpetuation of the kinds of operational environments that saddle most 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.

Managed properly, an enterprise architecture can clarify and help optimize the interdependencies and relationships among an organization's business operations and the underlying IT infrastructure and applications that support these operations. Employed in concert with other important IT management controls (such as portfolio-based capital planning and investment control practices), architectures can greatly increase the chances that organizations' operational and IT environments will be configured so as to optimize mission performance. Enterprise architectures are integral to managing large-scale programs in federal departments and agencies, as well as initiatives that span several agencies, such as those currently being undertaken to support OMB's electronic government (e-government)⁴ and "Line of Business"⁵ efforts.

Brief History of Enterprise Architecture Frameworks and Management Guidance

During the mid-1980s, John Zachman, widely recognized as a leader in the field of enterprise architecture, identified the need to use a logical construction blueprint (i.e., an architecture) for defining and controlling the integration of systems and their components.⁶ Accordingly, Zachman developed a structure or framework for defining and capturing an architecture, which provides for six

⁴ According to OMB, e-government is a mode of operations (using people, process, and technology—particularly Web-based Internet technology) to enhance access to and delivery of government information and service to citizens, business partners, employees, other agencies, and other levels of government. U.S. General Accounting Office, *Electronic Government: Initiatives Sponsored by the Office of Management and Budget Have Made Mixed Progress*, GAO-04-561T (Washington, D.C.: March 24, 2004).

⁵ According to OMB, the "Lines of Business" efforts will entail reviewing proposed investments in five areas (financial, human resources, grants, health, and case management systems) to identify common solutions and reduce costs.

⁶ J.A. Zachman, "A Framework for Information Systems Architecture," *IBM Systems Journal*, vol. 26, no. 3 (1987).

“windows” from which to view the enterprise.⁷ Zachman also proposed six abstractions or models associated with each of these perspectives.⁸ Zachman’s framework provides a way to identify and describe an entity’s existing and planned component parts, and the relationships between those parts, before the entity begins the costly and time-consuming efforts associated with developing or transforming itself.

Since Zachman introduced his framework, a number of frameworks have emerged within the federal government, beginning with the publication of the National Institute of Standards and Technology (NIST) framework in 1989. Since that time, other federal entities have issued enterprise architecture frameworks, including the Department of Defense (DOD) and the Department of the Treasury. In September 1999, the federal CIO Council published the Federal Enterprise Architecture Framework, which was intended to provide federal agencies with a common construct for their architectures, thereby facilitating the coordination of common business processes, technology insertion, information flows, and system investments among federal agencies. The Federal Enterprise Architecture Framework describes an approach, including models and definitions, for developing and documenting architecture descriptions for multiorganizational functional segments of the federal government.⁹

In February 2002, OMB established the Federal Enterprise Architecture Program Management Office to develop the FEA, which, according to OMB, is intended to facilitate governmentwide improvement through cross-agency analysis and identification of duplicative investments, gaps, and opportunities for collaboration,

⁷ The windows provide the viewpoints of (1) the strategic planner, (2) the system user, (3) the system designer, (4) the system developer, (5) the subcontractor, and (6) the system itself.

⁸ The models cover (1) how the entity operates, (2) what the entity uses to operate, (3) where the entity operates, (4) who operates the entity, (5) when entity operations occur, and (6) why the entity operates.

⁹ Similar to the Zachman framework, the Federal Enterprise Architecture Framework’s proposed models describe an entity’s business, data necessary to conduct the business, applications to manage the data, and technology to support the applications.

interoperability, and integration within and across agency programs. The FEA is composed of five “reference models” describing the federal government’s (1) business (or mission) processes and functions, independent of the agencies that perform them, (2) performance goals and outcome measures, (3) service delivery means, (4) information and data definitions, and (5) technology standards. The reference models are intended to inform agency efforts to develop their agency-specific enterprise architectures and enable agencies to ensure that their proposed investments are not duplicative with those of other agencies and to pursue, where appropriate, joint projects. The FEA reference models are summarized in table 1.

Table 1: FEA Reference Models

Reference model	Description	Status
Performance reference Model	Provides a common set of general performance outputs and measures for agencies to use to achieve business goals and objectives.	Version 1.0 released in September 2003
Business reference model	Describes the hierarchy of federal business operations independent of the agencies that perform them, including defining the services provided to state and local governments.	Version 2.0 released in June 2003
Service component reference model	Identifies and classifies IT service (i.e., application) components that support federal business operations and promotes the reuse of components across agencies.	Version 1.0 released in June 2003
Data and information reference model	Is intended to describe, at an aggregate level, the data and information types that support program and business line operations and the hierarchical relationships among these types.	Release planned in 2004
Technical reference model	Describes technology that is to support the delivery of service components, including relevant standards for implementing the technology.	Version 1.1 released in August 2003

Source: GAO analysis based on OMB data.

Although these post-Zachman frameworks differ in their nomenclatures and modeling approaches, most provide for defining an enterprise’s operations in both logical terms and technical terms, provide for defining these perspectives for the enterprise’s current and target environments, and call for a transition plan between the two.

Several laws and regulations have established requirements and guidance for agencies’ management of architectures, beginning with

the Clinger-Cohen Act in 1996,¹⁰ which directs the CIOs of major departments and agencies to develop, maintain, and facilitate the implementation of IT architectures as a means of integrating agency goals and business processes with IT. OMB Circular A-130, which implements the Clinger-Cohen Act, requires that agencies document and submit their initial enterprise architectures to OMB and updates when significant changes to their architectures occur. The circular also directs the OMB Director to use various kinds of reviews to evaluate the adequacy and efficiency of agency compliance with the circular.

OMB was given explicit responsibility for overseeing government enterprise architectures by the E-Government Act of 2002,¹¹ which established the Office of Electronic Government within the office. More specifically, it gives OMB the responsibility for facilitating the development of enterprise architectures within and across agencies and supporting improvements in government operations through the use of IT.

Prior Work Indicates Opportunities for Improving Enterprise Architectures

We began reviewing federal agencies' use of architectures in 1994, initially focusing on those agencies that were pursuing major systems modernization programs that were high risk. These included the National Weather Service systems modernization,¹² the Federal Aviation Administration air traffic control modernization,¹³ and the Internal Revenue Service tax systems modernization.¹⁴

¹⁰ Public Law 104-106, 40 U.S.C. 11315.

¹¹ Public Law 107-347.

¹² U.S. General Accounting Office, *Weather Forecasting: Systems Architecture Needed for National Weather Service Modernization*, [GAO/AIMD-94-28](#) (Washington, D.C.: Mar. 11, 1994).

¹³ U.S. General Accounting Office, *Air Traffic Control: Complete and Enforced Architecture Needed for FAA Systems Modernization*, [GAO/AIMD-97-30](#) (Washington, D.C.: Feb. 3, 1997).

¹⁴ U.S. General Accounting Office, *Tax Systems Modernization: Blueprint Is a Good Start but Not Yet Sufficiently Complete to Build or Acquire Systems*, [GAO/AIMD/GGD-98-54](#) (Washington, D.C.: Feb. 24, 1998).

Generally, we reported that these agencies' enterprise architectures were incomplete, and we made recommendations that they develop and implement complete enterprise architectures to guide their modernization efforts.

Since then, we have reviewed architecture efforts at other federal agencies, including the Department of Education,¹⁵ the former Customs Service,¹⁶ the former Immigration and Naturalization Service,¹⁷ the Centers for Medicare and Medicaid Services,¹⁸ the Department of Defense (DOD),¹⁹ the Federal Bureau of Investigation,²⁰ and the National Aeronautics and Space Administration.²¹ These reviews have identified the absence of complete and enforced enterprise architectures, which has led to agency business operations, systems, and data that are not integrated and that are duplicative and incompatible. These conditions, in turn, have either prevented agencies from sharing data or forced them to do so through inefficient manual processes or costly, custom-developed system interfaces.

¹⁵U.S. General Accounting Office, *Student Financial Aid Information: Systems Architecture Needed to Improve Programs' Efficiency*, [GAO/AIMD-97-122](#) (Washington, D.C.: July 29, 1997).

¹⁶U.S. General Accounting Office, *Customs Service Modernization: Architecture Must Be Complete and Enforced to Effectively Build and Maintain Systems*, [GAO/AIMD-98-70](#) (Washington, D.C.: May 5, 1998).

¹⁷U.S. General Accounting Office, *Information Technology: INS Needs to Better Manage the Development of Its Enterprise Architecture*, [GAO/AIMD-00-212](#) (Washington, D.C.: Aug. 1, 2000).

¹⁸U.S. General Accounting Office, *Medicare: Information Systems Modernization Needs Stronger Management and Support*, [GAO-01-824](#) (Washington, D.C.: Sept. 20, 2001).

¹⁹ U.S. General Accounting Office, *DOD Business Systems Modernization: Important Progress Made to Develop Business Enterprise Architecture, but Much Work Remains*, [GAO-03-1018](#) (Washington, D.C.: Sept. 19, 2003).

²⁰ U.S. General Accounting Office, *Information Technology: FBI Needs an Enterprise Architecture to Guide Its Modernization Activities*, [GAO-03-959](#) (Washington, D.C.: Sept. 25, 2003).

²¹ U.S. General Accounting Office, *Information Technology: Architecture Needed to Guide NASA's Financial Management Modernization*, [GAO-04-43](#) (Washington, D.C.: Nov. 21, 2003).

Our Enterprise Architecture Management Maturity Framework

To contribute to the evolution and maturity of the enterprise architecture discipline, in 2002, we published version 1.0 of our *Enterprise Architecture Management Maturity Framework* (EAMMF) as an extension of *A Practical Guide to Federal Enterprise Architecture, Version 1.0*, published by the CIO Council. By arranging core elements from the practical guide into a matrix of five hierarchical stages and four critical success attributes, this framework provides a common benchmarking tool for planning and measuring enterprise architecture efforts.²² In April 2003, we published version 1.1 of this framework,²³ which reflects changes and additions that are based on comments we received on the initial version, as well as on our experiences in reviewing enterprise architecture programs.

The EAMMF Version 1.0

EAMMF version 1.0 is made up of five stages of maturity, each of which includes an associated set of elements along with all the elements of the previous stages. In addition to the maturity stages, each core element is associated with attributes that are critical to the successful performance of any management function. Figure 1 shows a summary of version 1.0 of the framework and shows the key elements with the associated stages and attributes.

²²U.S. General Accounting Office, *Information Technology: Enterprise Architecture Use across the Federal Government Can Be Improved*, [GAO-02-6](#) (Washington, D.C.: Feb. 19, 2002).

²³U.S. General Accounting Office, *Information Technology: A Framework for Assessing and Improving Enterprise Architecture Management (Version 1.1)*, [GAO-03-584G](#) (Washington, D.C.: April 2003).

Figure 1: EAMMF (Version 1.0)

	Stage 1: Creating EA awareness	Stage 2: Building the EA management foundation	Stage 3: Developing architecture products	Stage 4: Completing architecture products	Stage 5: Leveraging the EA for managing change
Attribute 1: Demonstrates commitment	Agency is aware of EA.	Committee or group representing the enterprise is responsible for directing, overseeing, or approving EA.	Written/approved policy exists for EA development.	Written/approved policy exists for information technology investment compliance with EA.	Written/approved policy exists for EA maintenance.
Attribute 2: Provides capability to meet commitment		Program office responsible for EA development exists. Chief architect exists. EA being developed using a framework and automated tool.	EA products are under configuration management.		
Attribute 3: Demonstrates satisfaction of commitment		EA plans <ul style="list-style-type: none"> • call for describing enterprise in terms of business, data, applications, or technology; • call for describing "as is" environment, "to be" environment, or sequencing plan. 	EA products <ul style="list-style-type: none"> • describe or will describe enterprise's business—and the data, applications, and technology that support it; • describe or will describe "as is" environment, "to be" environment, and sequencing plan. EA scope is enterprise-focused.	EA products <ul style="list-style-type: none"> • describe enterprise's business—and the data, applications, and technology that support it; • describe "as is" environment, "to be" environment, and sequencing plan. Agency chief information officer has approved EA.	Either EA steering committee, investment review board, or agency head has approved EA.
Attribute 4: Verifies satisfaction of commitment					Metrics exist for measuring EA benefits.

Maturation

Source: GAO.

Note: Each stage includes all elements of the previous stages.

EAMMF Version 1.1

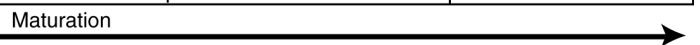
Version 1.1 of this framework was released in April 2003. Like the initial version, Version 1.1 is based on the CIO Council guidance,²⁴ augmented by our experience in reviewing agency architecture

²⁴ CIO Council, *A Practical Guide to Federal Enterprise Architecture, Version 1.0* (February 2001).

programs. Changes and additions to the framework were also based on comments received from federal agencies on the initial version. Figure 2 shows a summary of Version 1.1.

Figure 2: EAMMF (version 1.1)

	Stage 1: Creating EA awareness	Stage 2: Building the EA management foundation	Stage 3: Developing EA products	Stage 4: Completing EA products	Stage 5: Leveraging the EA to manage change
Attribute 1: Demonstrates commitment		Adequate resources exist. Committee or group representing the enterprise is responsible for directing, overseeing, or approving EA.	Written and approved organization policy exists for EA development.	Written and approved organization policy exists for EA maintenance.	Written and approved organization policy exists for IT investment compliance with EA.
Attribute 2: Provides capability to meet commitment		Program office responsible for EA development and maintenance exists. Chief architect exists. EA is being developed using a framework, methodology, and automated tool.	EA products are under configuration management.	EA products and management processes undergo independent verification and validation.	Process exists to formally manage EA change. EA is integral component of IT investment management process.
Attribute 3: Demonstrates satisfaction of commitment		EA plans call for describing both "as-is" and "to-be" environments of the enterprise, as well as a sequencing plan for transitioning from the "as-is" to the "to-be." EA plans call for describing both "as-is" and "to-be" environments in terms of business, performance, information/data, application/service, and technology. EA plans call for business, performance, information/data, application/service, and technology descriptions to address security.	EA products describe or will describe both "as-is" and "to-be" environments, as well as a sequencing plan. Both "as-is" and "to-be" environments are described or will be described in terms given in Stage 2. These descriptions (see Stage 2) address or will address security.	EA products describe both "as-is" and "to-be" environments, as well as a sequencing plan. Both "as-is" and "to-be" environments are described in terms given in Stage 2. These descriptions (see Stage 2) address security. Organization CIO has approved current version of EA. Committee or group representing the enterprise or the investment review board has approved current version of EA.	EA products are periodically updated. IT investments comply with EA. Organization head has approved current version of EA.
Attribute 4: Verifies satisfaction of commitment		EA plans call for developing metrics for measuring EA progress, quality, compliance, and return on investment.	Progress against EA plans is measured and reported.	Quality of EA products is measured and reported.	Return on EA investment is measured and reported. Compliance with EA is measured and reported.



Source: GAO.

Note: Each stage includes all elements of the previous stages.

Key Differences between EAMMF Versions 1.0 and 1.1

Overall, version 1.1 is more demanding (i.e., sets a higher standard) than version 1.0 because version 1.1 adds content and links the framework to related IT management guidance, such as our IT investment management framework.²⁵ Key differences in version 1.1 of the framework appear first in stage 2 and affect later stages either explicitly or implicitly. That is, some planning elements associated with stage 2 now propagate explicitly through later stages as plans are executed and architecture products are developed, completed, and implemented. For example:

- Version 1.1 includes “performance” among the models that are needed to describe the “as-is” and “to-be” environments; these models are introduced into the planning elements in stage 2 and built upon as plans are executed: that is, as architecture products are developed and completed in stages 3 and 4, respectively.
- Version 1.1 explicitly recognizes the need to address security in the descriptions of the “as-is” and “to-be” environments; this element is introduced in stage 2 and reiterated in stages 3 and 4.
- Version 1.1 introduces the need to plan for metrics in stage 2 and to measure different aspects of enterprise architecture development, quality, and use in stages 3, 4, and 5.

OMB Has Made Progress on FEA, but Questions Remain

In 2001, the lack of a federal enterprise architecture was cited by OMB’s E-Government Task Force as a barrier to the success of the administration’s e-government initiatives.²⁶ In response, OMB began developing the FEA, and over the last 23 months it has released various versions of all but one of the five FEA reference models. According to OMB, the purpose of the FEA, among other things, is

²⁵ U.S. General Accounting Office, *Information Technology Investment Management: A Framework for Assessing and Improving Process Maturity*, GAO-04-394G (Washington, D.C.: March 2004).

²⁶ OMB’s E-Government Task Force identified 23 initiatives (two additional initiatives were subsequently added) aimed at improving service to individuals, service to businesses, intergovernmental affairs, and federal agency-to-agency efficiency and effectiveness.

to provide a common frame of reference or taxonomy for agencies' individual enterprise architecture efforts and their planned and ongoing investment activities.

OMB reports that it first began using the FEA in 2002 as part of the fiscal year 2004 budget cycle to identify duplicative investments, gaps, and opportunities for collaboration, interoperability, and integration within and across government agency programs. OMB has since required agencies to use the FEA in developing their fiscal year 2005 budget submissions.²⁷ Despite OMB's progress, however, questions remain about the FEA.

OMB Has Cited a Number of Broad Purposes for the FEA

OMB has identified multiple purposes for the FEA. One purpose cited is to inform agencies' individual enterprise architectures and to facilitate their development by providing a common classification structure and vocabulary. Another stated purpose is to provide a governmentwide framework that can increase agencies' awareness of IT capabilities that other agencies have or plan to acquire, so that they can explore opportunities for reuse. Still another stated purpose is to help OMB decision-makers identify opportunities for collaboration among agencies through the implementation of common, reusable, and interoperable solutions. To this end, the business reference model states that OMB will use the FEA to analyze agency IT investments to identify

- which agencies share common business functions, processes, and activities;
- which budget requests support duplicative business functions and information systems; and
- where the government is investing money on redundant capabilities.

According to OMB, still another purpose of the FEA is to provide the Congress with information that it can use as it considers the authorization and appropriation of funding for federal programs.

²⁷ *Additional Guidance on the FEA-related Requirements in OMB Circular A-11*, Office of Management and Budget, Federal Enterprise Architecture Program Management Office.

OMB Has Released Versions of Four of Five FEA Reference Models

OMB has issued at least initial versions of four of the five reference models and plans to issue the fifth in the near future (see table 1). The following summarizes the purpose, content, and status of each reference model.

Performance reference model. According to OMB, the performance reference model is intended to produce IT performance information, articulate the contribution of IT to business outputs and outcomes, and identify performance improvement opportunities that cross organizational boundaries.

To accomplish these purposes, the model specifies measurement areas (e.g., mission and business results), measurement categories (e.g., services for citizens), and generic measurement indicators (e.g., delivery time) that agencies are to use to organize their respective measurement indicators. It also describes a process for agencies to use to identify and define these measurement indicators. Version 1.0 of the model was released in September 2003.

Business reference model. OMB characterizes the business reference model as being the foundation of the FEA. It describes the businesses of the federal government, independent of the agencies that perform them. According to OMB, the purpose of the business reference model is to provide the basis for analyzing IT investments and associated budget requests relative to whether they support common business functions, processes, and activities. OMB expects agencies to use the model as part of their capital planning and investment control processes to help identify opportunities for consolidating IT investments across the federal government.

The model consists of four *business areas*: (1) services for citizens, (2) mode of delivery, (3) support delivery of services, and (4) management of government resources. These four business areas are decomposed into 39 *lines of business*, which are made up of 153 *subfunctions*. Examples of lines of business under the “services for citizens” business area are homeland security, law enforcement, and economic development. For the homeland security line of business, an example of a subfunction is border and transportation security; for law enforcement, a subfunction example

is citizen protection; and for economic development, a subfunction example is financial sector oversight. Version 1.0 of the model was released to agencies in July 2002. In June 2003, version 2.0 was released.

Service component reference model. According to OMB, the service component reference model identifies and classifies IT service (i.e., application) components that support federal agencies so that OMB can identify, among other things, agencies that are building or have already built similar components that can be reused. Agencies are expected to use the service reference model to do the same.

The model is organized as a hierarchy, beginning with seven *service domains*. These service domains are decomposed into 29 *service types* (see table 2), which are further broken down into 168 *components*. For example, the customer services domain is made up of three service types: customer relationship management, customer preferences, and customer-initiated assistance. Components of the customer relationship management service type include call center management and customer analytics; components of the customer preferences service type include personalization and subscriptions; and components of the customer-initiated assistance service type include on-line help and on-line tutorials. Version 1.0 of the service component reference model was released in June 2003.

Table 2. Service Domains, the Capabilities That They Describe, and Associated Service Types

Service domain	Description	Service types
Customer services	Interaction between the business and the customer, including customer-driven activities (directly related to the end customer)	Customer preferences, customer relationship management, and customer-initiated assistance
Process automation services	Automation of processes and activities that support managing the business	Tracking and workflow, and routing and automation
Business management services	Management and execution of business functions and organizational activities that maintain continuity across the business	Management of process, organizational management, supply chain management, and investment management
Digital asset services	Generation, management, and distribution of intellectual capital and electronic media across the business	Content management, knowledge management, document management, and records management
Business analytical services	Extraction, aggregation, and presentation of information to facilitate decision analysis and business evaluation	Analysis and statistics, business intelligence, visualization, and reporting
Back office services	Management of transaction-based functions	Data management, human resources, financial management, assets/materials management, development and integration, and human capital/workforce management
Support services	Cross-functional capabilities that are independent of service domains	Security management, systems management, forms, communication, collaboration, and search

Source: OMB.

Data and information reference model. The data and information reference model is intended to help define the types of interactions and information exchanges that occur between the government and its customers. According to OMB, the model will describe data and information types that support program and business line operations and the relationships among these types. According to OMB officials, the model’s release is imminent.

Technical reference model. The technical reference model is intended to help agencies define their respective target technical architectures. It describes the standards, specifications, and technologies that collectively support the secure delivery, exchange, and construction of service components. OMB describes the model as being made up of the following four core service areas:

-
- *Service access and delivery*: the collection of standards and specifications that support external access, exchange, and delivery of service components.
 - *Service platform and infrastructure*: the delivery platforms and infrastructure that support the construction, maintenance, and availability of a service component or capability.
 - *Component framework*: the underlying foundation, technologies, standards, and specifications by which service components are built, exchanged, and deployed.
 - *Service interface and integration*: the collection of technologies, methodologies, standards, and specifications that govern how agencies will interface internally and externally with a service component.

Each of these four core service areas is made up of *service categories*, which identify lower levels of technologies, standards, and specifications; *service standards*, which define the standards and technologies that support the service category; and the *service specification*, which details the standard specification or the provider of the specification. For example, within the first core service area (service access and delivery), an example of a service category is *access channels*, and service standards are *Web browsers* and *wireless personal digital assistants*. Examples of *service specifications* for the Web browser service standard are Internet Explorer and Netscape Navigator. Version 1.0 of the technical reference model was released in January 2003 and then revised in August 2003 to incorporate minor revisions that were based, in part, on agencies' reviews. This version—version 1.1—was used during the 2005 budget process.

OMB Has Used the FEA to Identify Five Areas for Interagency Collaboration

As part of the fiscal year 2004 budget cycle, OMB required agencies to align business cases for their proposed IT investments to the business reference model; beginning with the fiscal year 2005 budget cycle, agencies were required to align their business cases to all the available reference models (i.e., the business, performance, technical, and service component reference models). This alignment activity was intended to result in the identification of redundancies and opportunities for collaboration. According to OMB, the fiscal

year 2004 IT investment budget review process identified potential redundancies in six lines of business. Further analysis of these six lines of business as part of the fiscal year 2005 IT budget process resulted in OMB settling on five lines of business in which to pursue opportunities for collaboration (i.e., financial management, human resources, grants, health, and case management).

Since then, OMB initiated a governmentwide analysis of these five lines of business to examine business and IT data and best practices for each. According to OMB, over the next several months, agency-led teams will identify common solutions and define a target architecture that is to be reflected in a business case for proposed IT investments for each line of business. The business cases are to be submitted for review in the fiscal year 2006 budget process. To this end, on April 15, 2004, OMB issued a formal request for information, seeking information from industry and government service providers on common solutions and target architectures for three of the five lines of business: financial management, human resources, and grants management.

OMB Plans to Improve the FEA and Expand Its Use

According to OMB officials, the FEA is in the early stages of its development and use, with future development and uses planned. OMB's plans for improving the FEA include releasing the previously mentioned data and information reference model, creating a plan for FEA management and maintenance, revising and consolidating reference models, and expanding use of the automated tool for collecting FEA data from agencies. Each is discussed below.

First, OMB plans to develop a formalized Management and Maintenance Plan that it says will provide explicit instructions to agencies on the roles, responsibilities, standards, and expectations for the management and upkeep of the FEA. Second, according to OMB, another planned activity is annually revising the reference models and consolidating all five reference models into one document. Specifically, it plans to (1) release a new version of the business reference model in mid-spring of each year, so that agencies will be able to use it when setting strategic budget priorities, and (2) create a consolidated set of models that,

according to OMB, will facilitate integration of the reference models and changes across all the models as they are updated. Finally, it is expecting agencies to expand their use of the Federal Enterprise Architecture Management System, so that agencies themselves, rather than OMB, will have the means to identify opportunities for collaboration internally as well as across agency boundaries.

Agencies Have Expressed High Levels of FEA Understanding and Support

As part of our governmentwide report on enterprise architecture maturity, we reported on federal agency views on the FEA, particularly agencies' understanding of and support for it and agencies' assessment of the impact of it on their respective enterprise architectures.²⁸ In general, we reported that most agencies understood and supported the FEA, although a handful did not. More specifically, of the 96 agencies that we contacted, about 80 percent told us that they understood the goals and objectives of the FEA (about 8 percent did not). Additionally, about 67 percent said that they understood the approach OMB was following to develop the FEA (about 13 percent did not).

Regarding agency support for the FEA, about 80 percent of the agencies said that they supported its goals and objectives (about 6 percent did not); about 63 percent stated that they supported OMB's approach to developing the FEA (about 10 percent did not). Further, about 72 percent told us that their respective architectures were traceable to the FEA (about 6 percent were not). With respect to its impact, about 61 percent of the agencies said that their respective enterprise architectures would change as a result of the FEA (about 8 percent did not). (See table 3.)

²⁸ [GAO-04-40](#).

Table 3: Summary of Agencies' Positions on the FEA

Statement	Percentage of agencies that agreed	Percentage of agencies that disagreed	Percentage of agencies that neither agreed nor disagreed
Understand the goals and objectives	80	8	12
Understand OMB's approach to development	67	13	20
Support the goals and objectives	80	6	14
Support OMB's approach to development	63	10	27
Can trace enterprise architecture to the FEA	72	6	22
Will change enterprise architecture as a result of the FEA	61	8	31

Source: GAO.

As the FEA Continues to Evolve, Questions Need to Be Addressed

Despite OMB progress in developing the FEA, questions remain. We raise these questions in an effort to enhance agency understanding of the FEA and facilitate its use. As OMB continues to mature the FEA, these questions should be addressed.

Should the FEA be described as an enterprise architecture? As discussed earlier in this statement, a true enterprise architecture is intended to provide a blueprint for optimizing an organization's business operations and implementing the IT that supports them. Accordingly, well-defined enterprise architectures describe, in meaningful models, both the enterprise's "as-is" and "to-be" environments, along with the plan for transitioning from the current to the target environment. To be meaningful, these models should be inherently consistent with one another, in view of the many interrelationships and interdependencies among, for example, business functions, the information flows among the functions, the security needs of this information, and the services and applications that support these functions.

Our reading of the four available reference models does not demonstrate to us that this kind of content exists in the FEA, and thus we believe that the FEA is more akin to a point-in-time framework or classification scheme for federal government operations. Our discussions with OMB officials confirmed our

reading of the FEA. Accordingly, if agencies use the FEA as a model for defining the depth and detail for their own architectures, the agencies' enterprise architectures may not provide sufficient content for driving the implementation of systems.

Is the expected relationship between agencies' enterprise architectures and the FEA clearly articulated? According to OMB, the FEA is to inform agency enterprise architectures. For example, OMB has stated that although it is not mandating that the business reference model serve as the foundation for every agency's business architecture, agencies should invest time mapping their respective business architectures to the FEA. Similarly, OMB has stated that agencies' alignment of their respective architectures to the service component reference model and the technical reference model will enable each agency to categorize its IT investments according to common definitions.

Such descriptions of the agency enterprise architecture/FEA relationship, in our view, are not clear, in part because definitions of such key terms as *alignment*, *mapping*, and *consistency* were not apparent in the FEA. As with any endeavor, the more ambiguity and uncertainty there is with requirements and expectations, the greater the use of assumptions and thus deviation from the intended course of action. This is particularly true in the area of enterprise architecture.

How will the security aspects of the FEA be addressed? Our work has found that a well-defined enterprise architecture should include explicit discussion of security, including descriptions of security policies, procedures, rules, standards, services, and tools.²⁹ Moreover, security is an element of the very fabric of architecture artifacts and models and thus should be woven into them all. As our experience in reviewing agency security practices and research of

²⁹ U.S. General Accounting Office, *DOD Business Systems Modernization: Important Progress Made to Develop Business Enterprise Architecture, but Much Work Remains*, [GAO-03-1018](#) (Washington, D.C.: Sept. 19, 2003).

leading practices shows, security cannot be an afterthought when it comes to engineering systems or enterprises.³⁰

OMB has stated that it plans to address security through what it terms a “security profile” to be added to the FEA. However, OMB officials could not comment on the profile’s status or development plans, beyond stating that the CIO Council is taking the lead in developing the profile.

Overall, Federal Agency Architecture Management Is Not Mature, but Some Agencies Are Doing Well and Efforts Are under Way to Advance Governmentwide Maturity

As we reported in 2003, while some agencies have made progress in improving their enterprise architecture management maturity, progress for the federal government as a whole has not occurred.³¹ In particular, the percentage of agencies that had established at least the foundation for effective enterprise architecture management was virtually unchanged from where it was in 2001 (about 50 percent). Further, we reported that when the state of enterprise architecture is considered in relation to a more recent and demanding benchmark, this percentage dropped to about 20 percent (in round terms), even though some agencies fared favorably against this benchmark and were role models for others to follow. This composite picture of immature enterprise architecture management can be attributed to several long-standing challenges, which were the basis for the recommendations that we made to OMB in 2002 and reiterated in 2003. Recently, OMB and the federal CIO Council began to take steps that are consistent with many of our recommendations.

³⁰ U.S. General Accounting Office, *Information Security Management: Learning From Leading Organizations*, [GAO/AIMD-98-86](#) (Washington, D.C.: May 1998).

³¹ [GAO-04-40](#).

Governmentwide Progress in Managing Enterprise Architecture Has Been Limited

Between 2001 and 2003, little substantial change was revealed in agencies' collective enterprise architecture maturity, when this is compared against version 1.0 of our framework.³² Of the 93 agencies that we reported on in 2001 and 2003,

- 22 agencies (24 percent) increased their maturity,
- 24 agencies (26 percent) decreased their maturity, and
- 47 agencies (51 percent) remained the same.³³

Agencies' progress between 2001 and 2003 is similarly limited when we consider the total number of EAMMF core elements satisfied. Specifically, the 93 agencies satisfied about 57 percent of all possible framework elements in 2001 and about 60 percent in 2003. Upon further inspection, these data show that agencies improved in satisfying certain core elements, but these improvements were offset by declines in satisfaction of other core elements. The following are examples of elements where agency satisfaction significantly improved:

- "Metrics exist for measuring enterprise architecture benefits" (about a 38 percent increase),
- "Chief architect exists" (about a 23 percent increase), and
- "Enterprise architecture products are under configuration management" (about an 18 percent increase).

The following are examples of core elements where agency satisfaction significantly declined:

- "Enterprise architecture products describe 'as-is' environment, 'to-be' environment, and sequencing plan" (about a 39 percent decrease),

³² [GAO-04-40](#).

³³ Numbers do not add to 100 percent due to rounding.

- “Enterprise architecture products describe enterprise’s business—and the data, applications, and technology that support it” (about a 36 percent decrease),
- “Either enterprise architecture steering committee, investment review board, or agency head has approved enterprise architecture” (about a 25 percent decrease), and
- “Program office responsible for enterprise architecture development exists” (about a 23 percent decrease).

For the 22 agencies that advanced one or more maturity stages from 2001 to 2003, completion of no single core element accounted for these advancements. That is, for the 22 agencies, increases in maturity stages are most often attributable to the fulfillment of 7 core elements spanning 3 stages of maturity. Table 4 shows those newly satisfied core elements that most often accounted for an increase in a maturity stage.

Table 4: Core Elements That Most Frequently Contributed to Maturity Stage Increases

Agencies increasing maturity stage	Core elements whose fulfillment most frequently contributed to increase	Number of agencies fulfilling element
12 agencies increased maturity from stage 1 (6 to stage 2, 6 to stage 3)	Stage 2 elements:	
	Chief architect exists	6 of 12
	Program office responsible for enterprise architecture development exists	6 of 12
	Committee or group representing the enterprise is responsible for directing, overseeing, or approving enterprise architecture	6 of 12
8 agencies increased maturity from stage 2 (6 to stage 3, 1 to stage 4, 1 to stage 5)	Enterprise architecture being developed using framework and automated tool	4 of 12
	Stage 3 elements:	
	Enterprise architecture products are under configuration management	7 of 8
2 agencies increased maturity from stage 4	Written and approved policy exists for enterprise architecture development	5 of 8
	Stage 5 element:	
	Metrics exist for measuring enterprise architecture benefits	2 of 2

Source: GAO analysis of survey data.

As with increases in agency maturity levels, no single core element accounted for the decreases in agency maturity between 2001 and 2003. However, as shown in table 5, the stage 2 framework element requiring a program office was the most significant newly

unsatisfied element for the 24 agencies that had decreased maturity levels.

Table 5: Core Elements That Most Frequently Contributed to Maturity Stage Decreases

Agencies decreasing maturity stage	Core elements whose fulfillment most frequently contributed to decrease	Number of agencies not fulfilling element
16 agencies decreased maturity to stage 1 (12 from stage 2, 4 from stage 3)	Stage 2 elements:	
	Program office responsible for enterprise architecture development exists	13 of 16
	Chief architect exists	4 of 16
7 agencies decreased maturity to stage 2 (6 from stage 3, 1 from stage 4)	Stage 3 elements:	
	Written and approved policy exists for enterprise architecture development	6 of 7
	Enterprise architecture products are under configuration management	3 of 7
1 agency decreased maturity to stage 3 (from stage 4)	Stage 4 elements:	
	Enterprise architecture products describe 'as-is' environment, 'to-be' environment, and sequencing plan	1 of 1
	Enterprise architecture products describe enterprise's business—and the data, applications, and technology that support it	1 of 1

Source: GAO analysis of survey data.

One factor contributing to the decreases in maturity between 2001 and 2003 is improved accuracy in agencies' responses to our data collection instrument. Improved accuracy is a function of (1) improved agency familiarity with and understanding of enterprise architecture management and our framework and (2) the requirement in our 2003 work for documentation to support certain agency responses.

Overall, the State of Architecture Development and Use in Federal Agencies Is Uneven and Needs to Improve

When compared against version 1.1 of our framework, the state of enterprise architecture management across the federal government is not mature. In particular, about 21 percent of federal agencies (20 of 96) have the stage 2 management foundation that is needed to begin successfully developing, implementing, and maintaining an enterprise architecture, and about 79 percent of agencies (76 of 96) have not yet advanced to this basic stage of maturity. (One agency, the Executive Office of the President, was at a stage of maturity that can be considered effective.) This overall state of maturity is

consistent for each of the three agency groups surveyed: departments, component agencies, and independent agencies.

No single core element that was added to our framework contributed significantly to this current state, but the “methodology” subelement of the stage 2 element “Enterprise architecture is being developed with a framework, methodology, and automated tool” was the most significant factor that kept agencies from achieving stage 2. The absence of a “methodology” kept seven agencies from attaining stage 2 status.

Nevertheless, certain core elements of version 1.1 of our framework were frequently not satisfied by agencies. Of the 31 core elements in version 1.1, 17 were not satisfied by more than 50 percent of the agencies. Further, 8 elements associated with stages 4 and 5 were not satisfied by about 80 percent of the agencies.

Although significant gaps existed across federal agencies in meeting the core elements of version 1.1 of the framework, at least 80 percent of the agencies reported performing 8 core elements that were related to stages 2 and 3. The most often satisfied elements included the following stage 2 elements:

- “Enterprise architecture plans call for describing both the ‘as-is’ and the ‘to-be’ environments of the enterprise, as well as a sequencing plan for transitioning from the ‘as-is’ to the ‘to-be’”(about 94 percent);
- “Enterprise architecture plans call for describing both the ‘as-is’ and the ‘to-be’ environments in terms of business, performance, information/data, application/service, and technology” (about 90 percent); and
- “Enterprise architecture plans call for business, performance, information/data, application/service, and technology descriptions to address security” (about 86 percent).

The most often satisfied elements also included the stage 3 element

- “Enterprise architecture products describe or will describe both the ‘as-is’ and the ‘to-be’ environments of the enterprise, as well as a

sequencing plan for transitioning from the ‘as-is’ to the ‘to-be’” (about 88 percent).

In addition, although only one agency has achieved stage 5, many agencies reported satisfying the stage 5 core elements requiring that IT investments comply with their enterprise architecture (about 80 percent) and that enterprise architecture is an integral component of their IT investment management process (about 69 percent).

Departments, component agencies, and independent agencies had varying degrees of success satisfying certain core elements within individual stages. In general, departments had more success satisfying lower stage elements than did components and independent agencies. In stage 2, for example, while 69 percent of departments reported using a framework, methodology, and automated tool to develop their enterprise architecture, only 29 percent of components and 50 percent of independent agencies reported the same. Additionally, in stage 3, while 81 percent of departments reported that progress against plans is measured and reported, only 25 percent of components and 25 percent of independent agencies reported the same. One possible reason for this situation is that OMB’s oversight of agency enterprise architecture efforts focuses on departments and major independent agencies—not on component agencies.

Although, as a whole, departments satisfied more lower-level framework elements than did component agencies and independent agencies, departments generally still would need to satisfy several lower-level framework elements to achieve a stage 3 maturity level. On average, each department needs to satisfy 2 core elements to satisfy all stage 2 and 3 framework elements.

The maturity stage of a department generally was not indicative of the maturity of its component agencies. For example, the Departments of Health and Human Services and Transportation reached stage 2, while their component agencies averaged stage 1.

Also, DOD's Global Information Grid architecture³⁴ was at stage 3, while its business enterprise architecture was at stage 1, as were its components, in general. Conversely, the Departments of Commerce, Justice, and the Treasury were at stage 1, with their component agencies averaging higher maturity levels; the component agencies of Commerce showed a slightly higher maturity level than did component agencies of all other departments. That is, the average maturity level of all component agencies we surveyed was 1.23, but the Commerce component agencies averaged 1.80, largely owing to the maturity levels for the Bureau of the Census (stage 3), the U.S. Patent and Trademark Office (stage 2), and the National Oceanic and Atmospheric Administration (stage 2). The Department of Agriculture's maturity level (stage 1) was the same as the average maturity level of its component agencies.

Eight Agencies Were Well Positioned to Achieve Stage 5 Maturity, and Many Agencies Were Performing Core Elements beyond Their Assigned Maturity Stages

Although the Executive Office of the President was the sole stage 5 agency, seven other agencies were close to becoming models of enterprise architecture management. For example, the Office of Personnel Management (OPM), which achieved stage 1 of version 1.1, needed to satisfy only five more elements to become a stage 5 agency. OPM needed to satisfy one stage 2 element ("Enterprise architecture plans call for developing metrics for measuring enterprise architecture progress, quality, compliance, and return on investment"), one stage 3 element ("Progress against enterprise architecture plans is measured and reported"), two stage 4 elements ("Enterprise architecture products and management processes undergo independent verification and validation" and "Quality of enterprise architecture products is measured and reported"), and one stage 5 element ("Return on enterprise architecture investment is measured and reported").

³⁴The GIG architecture describes the globally interconnected, end-to-end set of information capabilities, associated processes, and personnel for collecting, processing, storing, disseminating, and managing information on demand to war fighters, policy makers, and support personnel.

Ninety-six percent of agencies in stages 1 through 4 were performing at least one core element above their current maturity stage,³⁵ which means that as a whole, agencies are, to varying degrees, performing above their assigned maturity stages. Specifically, of the 76 agencies at stage 1, about 95 percent were performing at least one core element in a higher maturity stage. About 35 percent of agencies need to satisfy only one additional core element to advance to at least the next maturity stage. Two of these agencies, Commerce and the U.S. Mint, could advance two stages by satisfying just one additional core element. Commerce, currently a stage 1 agency, could advance to stage 3 by satisfying the framework element “Program office responsible for development and maintenance exists.” The Mint, also currently a stage 1 agency, could advance to stage 3 by satisfying the framework element “Adequate resources exist.”

Agencies Identified Enterprise Architecture Management Challenges

Agencies continue to face the same management challenges that we identified in 2001—that is, obtaining top management support and commitment, overcoming parochialism, and having the requisite resources (financial and human capital) to accomplish the work. Moreover, the prevalence of these challenges has grown. For example, getting top management to understand the purpose, content, and value of architectures was seen as a challenge by about 50 percent of agencies—up from 39 percent in 2001. As our framework recognizes, obtaining executive understanding and support is essential to having an effective enterprise architecture program. Without it, agencies will have increased difficulty in addressing other challenges such as overcoming parochialism among organizational components and obtaining requisite resources (funding and human capital). Our work in 2003 bears this out—at the same time that the percentage of agencies identifying top management understanding and support as a challenge rose, the percentage of agencies identifying these other challenges almost all

³⁵One agency—the Executive Office of the President—is currently performing at stage 5 and cannot perform above its current maturity stage. As a result, it is excluded from this analysis.

rose. For example, the percentage that identified parochialism as a challenge grew from about 39 to 47 percent. Also, while about 50 percent of agencies continued to report funding as a significant challenge, the percentage of agencies that reported obtaining skilled staff as a challenge grew from about 32 to 49 percent. (See table 6.)

Table 6: Change in Prevalence of Enterprise Architecture Management Challenges

Management challenge	Percentage of agencies that frequently identified management challenge	
	2001 survey	2003 survey
Fostering top management understanding	39	50
Overcoming parochialism	39	47
Ensuring adequate funding	50	50
Obtaining skilled staff	32	49

Source: GAO analysis of survey data.

Agencies have also reported mixed levels of satisfaction with OMB's efforts to address these management challenges. Specifically, just over half of the agencies were satisfied with OMB's efforts to foster top management understanding and to overcome agency component organization parochialism (about 58 and 53 percent, respectively). Moreover, fewer than half of the agencies (40 percent) were satisfied with OMB's actions to address their enterprise architecture funding and staffing challenges. (See table 7.)

Table 7: Percentage of Agencies Satisfied with OMB's Efforts to Address Various Management Challenges

Management challenge	Percentage of agencies satisfied ^a	Percentage of agencies dissatisfied ^a	Percentage of agencies neither satisfied nor dissatisfied ^a
Fostering top management understanding	58	14	27
Overcoming parochialism	53	10	37
Ensuring adequate funding	40	26	34
Obtaining skilled staff	40	15	45

Source: GAO analysis of survey data.

^a Numbers do not add to 100 percent due to rounding.

OMB and the Federal CIO Council Have Recently Acted to Strengthen Agency Enterprise Architecture Maturity

Both OMB and the federal CIO Council have long been advocates of enterprise architecture. For example, in collaboration with others and us, OMB issued guidance on the purpose and use of enterprise architectures shortly after passage of the Clinger-Cohen Act of 1996.³⁶ Subsequently, it incorporated enterprise architecture considerations into its oversight processes and issued guidance directing that agency IT investments be based on agency enterprise architectures.³⁷ Further, OMB collaborated with the CIO Council and us on the *Practical Guide to Federal Enterprise Architecture, Version 1.0*. As a means of promoting agencies' enterprise architecture use, OMB has also included requirements for having and using enterprise architectures as part of the budget process, which began with the fiscal year 2002 budget cycle and, according to OMB officials, has continued since then. OMB has also worked through the CIO Council, which is chaired by OMB, to improve enterprise architecture management and use.

Despite OMB's longstanding advocacy and support for enterprise architecture, we reported in 2002 that OMB needed to advance the level of enterprise architecture management maturity by exercising stronger leadership and improved oversight and by identifying governmentwide solutions to common enterprise architecture management challenges facing agencies. Accordingly, we recommended that the OMB Director, in collaboration with the federal CIO Council, use our maturity framework and the agency baseline information provided in our February 2002 report as the basis for helping agencies to advance the state of their respective enterprise architecture development, implementation, and maintenance efforts, and for measuring agency progress. We further recommended that in doing so, the OMB Director require agencies to (1) submit to OMB an annual update of the agency's satisfaction

³⁶ OMB, *Information Technology Architectures*, Memorandum M-97-16 (June 18, 1997); rescinded with the update of OMB Circular A-130 (Nov. 28, 2000).

³⁷ OMB, *Management of Federal Information Resources*, Circular No. A-130 (Nov. 28, 2000).

of each of the core elements contained in our maturity framework and (2) have this update verified by the agency's inspector general or comparable audit function before it is submitted to OMB. Additionally, we recommended that the OMB Director, in collaboration with the CIO Council, develop and implement a plan to address the governmentwide impediments to greater agency use of enterprise architectures. We recommended that, at a minimum, this plan should include the two primary challenges identified in our 2002 report—that is, agency executive management understanding of enterprise architectures and the availability of enterprise architecture human capital expertise. Finally, we recommended that the director report annually to the Senate Committee on Governmental Affairs and the House Committee on Government Reform on the results of OMB's annual update of the state and progress of federal agencies' enterprise architecture efforts. OMB officials generally agreed with the findings and conclusions of our report and stated that they would consider using our framework.

As previously noted, we reported in 2003 that agencies had collectively made little progress toward improving their enterprise architecture maturity. In commenting on this report, OMB officials told us that they were still considering using our framework as a basis for evaluating agencies' progress in developing and implementing their architectures, but had not committed to doing so because they were still reviewing options. Additionally, these officials did not have any plans to address governmentwide impediments to greater agency use of architectures. Further, they said that OMB has provided and plans to continue to provide information to the Congress on the state of agency enterprise architecture efforts and on progress in implementing the FEA. As a result, we again called for stronger leadership and reiterated the recommendations we made in our February 2002 report, with the modification that OMB use version 1.1 of our framework and the baseline data from our 2003 report. Additionally, we recommended that the OMB Director, in developing and implementing the plan we previously recommended to address governmentwide impediments to greater agency use of enterprise architectures, ensure that the plan provides for identifying agencies that have effectively overcome enterprise architecture management challenges and sharing those and other lessons learned and best practices. Also, we

recommended that the director, in annually reporting to the Senate Committee on Governmental Affairs and the House Committee on Government Reform, as we previously recommended, include in the report what steps have been taken to implement our recommendations, including reasons for not adopting our maturity framework.

OMB and the CIO Council have recently initiated actions consistent with many of our recommendations. For example, the council established a Chief Architect Forum, the first meeting of which was held on April 5, 2004, and in which we participated. This forum has created a means for chief architects across federal agencies to systematically collaborate on matters of mutual concern and interest. Vehicles for this collaboration include periodic meetings, a listserv to share information and ideas, and special gatherings that focus on specific issues. As another example, OMB recently released for comment version 1.0 of an agency enterprise architecture assessment tool. The tool is intended to help individual agencies assess their enterprise architecture programs. According to OMB, this initial version will be revised to reflect comments it receives.

In summary, enterprise architecture development and use in the federal government are maturing, but they are not mature. Given that effective development and use of enterprise architectures are critical to federal agencies achieving breakthrough levels of performance, senior leadership across the government needs to elevate its attention to this essential transformation and modernization tool. While progress on this front has occurred over the last few years, it has been spotty, and in our view, considerable maturation is needed before the federal government will be positioned to reap the rewards that others have reported from effective architecture development and use. The fact remains that until agencies have and use well-defined enterprise architectures, they will be severely challenged in their ability to effectively leverage IT in transforming their operations. Recent steps by OMB and the CIO Council to assume stronger leadership roles are encouraging. However, hard work lies ahead to clarify and evolve

the FEA, and to ensure that well-managed architecture programs—ones that produce architecture blueprints that can be implemented and become integral parts of the fabric of institutional strategic planning, investment decision-making, and budget execution—are actually established across the government. These are important goals, which we support, and we will continue to work with OMB and the CIO Council throughout the multistep process needed to ensure that the FEA is appropriately described, matured, and used, and to advance the state of agency enterprise architecture efforts.

Mr. Chairman, that concludes my testimony. I would be pleased to answer any questions that you and the other Members of the Subcommittee may have.

Contact and Acknowledgements

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