# Audit of Enterprise Architecture

**FINAL AUDIT REPORT**
**ED-OIG/A07-C0001**
**September 2002**

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U.S. Department of Education
Office of Inspector General
Kansas City, Missouri Office

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Statements that managerial practices need improvements, as well as other conclusions and recommendations in this report represent the opinions of the Office of Inspector General. Determinations of corrective action to be taken will be made by the appropriate Department of Education officials.

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UNITED STATES DEPARTMENT OF EDUCATION

OFFICE OF INSPECTOR GENERAL

**MEMORANDUM**

SEP 3 0 2002

**TO:** Craig B. Luigart
Chief Information Officer

Theresa S. Shaw
Chief Operating Officer, Federal Student Aid

**FROM:** Andrew Patchan Jr.
Senior Director, Systems Internal Audit Team

**SUBJECT:** FINAL AUDIT REPORT
Audit of Enterprise Architecture
Control No. ED-OIG/A07-C0001

Attached is our final audit report presenting our findings and recommendations resulting from our review of the Department's and FSA's efforts to develop an enterprise architecture in compliance with the Clinger-Cohen Act of 1996. The report identifies areas for improvement and provides recommendations. We received your comments, which basically concurred with the findings in our draft audit report.

In accordance with Office of Management and Budget Circular A-50, we will keep this audit report on the Office of Inspector General (OIG) list of unresolved audits until all open issues have been resolved. Any reports unresolved after 180 days from the date of issuance will be shown as overdue in the OIG's Semiannual Report to Congress.

Please provide us with your final response to each open recommendation within 60 days of the date of this report indicating what corrective actions you plan or have already taken, and related milestones. Please provide the Supervisor, Post Audit Group – Office of the Chief Financial Officer with semi-annual status reports on corrective actions until all such actions have been completed or continued follow-up is unnecessary. In accordance with the Freedom of Information Act (5 U.S.C. §552), reports issued by the Office of Inspector General are available, if requested, to members of the press and general public to the extent information contained therein is not subject to exemptions in the Act.

We appreciate the cooperation given us in the review. Should you have any questions concerning this report, please call William Allen at (816) 880-4024. Please refer to the above audit control number in all correspondence relating to this report.

Attachment

# Audit of Enterprise Architecture

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# Audit of Enterprise Architecture

## Executive Summary

We reviewed the Department of Education's (Department) and Federal Student Aid's (FSA) enterprise architectures for information technology to determine the status of the development of their architectures. Specifically, we determined whether (1) the Department's and FSA's enterprise architecture activities were consistent with the Federal Enterprise Architecture Framework, and (2) FSA's and the Department's architectures were compatible and interfaced with each other. Although both the Department and FSA have made progress in laying the groundwork for their enterprise architectures, critical elements need to be completed; specifically, the architectures need to be integrated, and data standardization characteristics and techniques need to be fully implemented.

An enterprise architecture is a blueprint for guiding and constraining business and technological change for an enterprise, which is necessary to ensure that information technology investments are selected, controlled, and evaluated in context with an overall information technology strategy. The General Accounting Office (GAO) reported[1] that based on a survey of Federal agencies, most agencies were in the early stages of developing enterprise architectures. Using a scale that included five stages,[2] GAO reported that the Department was at stage two – defined as building the enterprise architecture management foundation.

We found that the Department has completed the core elements listed in stage two and is currently performing core elements related to stages three and four. We also determined that FSA is performing core elements related to stage four, but it had not used an automated tool in developing its enterprise architecture, which is a core element of stage two. FSA had recently designated a Chief Architect to provide direction and support for a structured development approach, which is also a core element of stage two. The Department is lacking the basic building blocks of an architecture, including a final baseline architecture and target architecture. FSA has completed these building blocks but needs to complete core elements associated with stage two.

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[1] *Information Technology: Enterprise Architecture Use across the Federal Government Can Be Improved* (GAO-02-6), February 2002.

[2] GAO defined the five stages of maturity in the process of developing an enterprise architecture: Stage 1 – creating enterprise architecture awareness; Stage 2 – building the enterprise architecture management foundation; Stage 3 – developing architecture products; Stage 4 – completing enterprise architecture products; and Stage 5 – leveraging the enterprise architecture for managing change (see pages 3-4, and Appendix I for a more complete description of what each stage entails).

We also found that the Department had not made any provisions for incorporating FSA's architecture into a department-wide architecture. As a result of concerns raised by the Office of Management and Budget (OMB) in its Analytical Perspective on the fiscal year (FY) 2003 budget, the Department and FSA have committed to working together. However, efforts to integrate the two architectures have been delayed pending agreement on a Memorandum of Understanding. Without an integrated department-wide enterprise architecture, the Department and FSA risk acquiring and developing systems that may not be able to communicate with each other.

Neither the Department nor FSA had fully implemented the use of common identifiers for students and institutions and had not reached agreement on data characteristics and standards for use in department-wide system applications. Further, the Department had not established a common data dictionary[3] for departmental and FSA programs. Instead, each Department program uses its own data dictionary for its own system. The lack of data standards contributes to problems with data quality and reliability, making it difficult to track students across programs.

We recommend that the Department and FSA (1) complete remaining critical steps in developing an enterprise architecture; (2) complete the integration of the FSA and Department architecture efforts into one department-wide architecture through the Enterprise Architecture Working Group and other related efforts; and (3) agree on common data characteristics and standards from which they can develop a department-wide data dictionary.

The Department and FSA generally agreed with our findings but disagreed with some recommendations. We have incorporated their comments, where appropriate, and have summarized the Department's/FSA's comments and OIG's response at the end of each respective finding. The full text of the Department's comments are included as Appendix IV.

[3] A data dictionary is a repository of information describing the characteristics of data used to design, monitor, document, protect, and control data in information systems and databases.

## Audit Results

Developing an enterprise-wide information technology (IT) architecture is a challenging and necessary process to ensure that information technology investments are selected, controlled, and evaluated in a cost-effective and efficient manner, within the context of an overall information technology strategy. The Office of Management and Budget (OMB) guidelines state that in creating an architecture, agencies must identify and document business processes; information flows and relationships; applications, data descriptions and relationships; and the technology infrastructure. The architecture is then used to provide a roadmap from an organization's current (baseline) operational and technological environment toward the desired (target) state. Many Federal agencies are still in the early stages of developing an information technology architecture. We reviewed the Department's and FSA's enterprise architectures for information technology to determine whether (1) the architectures were consistent with the Federal Enterprise Architecture Framework, and (2) FSA's and the Department's architectures were compatible and interfaced with each other.

Both the Department and FSA have made progress in taking specific actions to lay the groundwork for their enterprise architectures, however, critical elements need to be completed in order for the Department and FSA to have a functioning enterprise architecture in place for acquiring and using systems across the Department in a cost-effective and efficient manner. In addition, the Department and FSA have not (1) made provisions for integrating their separate enterprise architectures into a department-wide enterprise architecture, and (2) fully implemented data standardization characteristics and techniques such as the use of common identifiers for students and institutions for use in department-wide system applications.

## **Finding No. 1** – The Department and FSA are Making Progress in Developing An Enterprise Architecture But Challenges Remain

The OMB guidelines[4] require Federal agencies to develop and implement enterprise architectures to provide a framework for evolving or maintaining existing and planned information technology, and for evaluating investments in terms of the entity's progress toward the desired operational and technological

[4] *Management of Federal Information Resources*, OMB Circular A-130 (November 30, 2000).

environment. Federal agencies have been challenged in implementing OMB's guidance for designing enterprise architectures that guide capital planning and investment decisions. In a 2002 survey[5] of Federal agencies' efforts in developing architectures, the General Accounting Office (GAO) determined that most Federal agencies had achieved stage one or two of an architecture maturity framework, with the Department at stage two. Guidance issued last year by the Federal Chief Information Officer (CIO) Council[6] provides detailed steps for developing IT architectures to provide a framework for evolving information systems, developing new systems, and inserting new technologies that optimize an organization's mission value. The Department and FSA have each completed key steps recommended by the CIO Council guidance but have a number of critical steps remaining.

GAO evaluated the agencies' progress using an enterprise architecture maturity framework, developed from the CIO Council guidance, that defines five stages of architecture maturity and necessary core elements (see Appendix I for a more complete description and what steps the Department and FSA have completed in relation to each stage of maturity):

- ***Stage 1: Creating EA [Enterprise Architecture] Awareness*** *is characterized by either no plans to develop and use an EA, or plans and actions that do not yet demonstrate an awareness of the value of having and using one.*

- ***Stage 2: Building the EA Management Foundation*** *focuses on assignment of roles and responsibilities and establishment of plans for developing EA products.*

- ***Stage 3: Developing Architecture Products*** *focuses on actual development of EA products.*

- ***Stage 4: Completing EA Products*** *is characterized by complete and approved EA products that the agency can use to help select and control its portfolio of IT investments.*

- ***Stage 5: Leveraging the EA for Managing Change*** *entails evolving the products according to a written and approved policy for EA maintenance.*

[5] *Information Technology: Enterprise Architecture Use across the Federal Government Can Be Improved* (GAO-02-6), February 2002.
[6] *A Practical Guide to Federal Enterprise Architecture*, Version 1.0 (February 2001).

Based on a survey of Federal agencies, using a scale of stage one to five, GAO reported most agencies were performing core elements related to stages two and three, with the Department's progress reported as stage two.[7]

In our audit, we found that the Department has completed the core elements listed in stage two of GAO's maturity model and is in the process of performing core elements related to stages three and four. FSA is performing core elements related to stage four, but it has not completed all of the core elements defined in stage two because it had not selected or acquired an automated tool in developing its enterprise architecture. FSA had only recently designated a Chief Architect to provide direction and support for a structured development approach, which is also a core element of stage two.

Both the Department and FSA have made progress in taking specific actions to lay the groundwork for their enterprise architectures. However, the Department is lacking some basic building blocks, and FSA has the building blocks but needs to complete core elements associated with stage two. Both the Department and FSA need to complete critical elements in order to have a functioning enterprise architecture in place for acquiring and using systems across the Department in a cost-effective and efficient manner.

The Department's Status and Critical Elements Remaining

Although the Department is systematically approaching the development of an enterprise architecture, given its current status of development, the Department's enterprise architecture lacks the basic building blocks of an architecture. As of the date of our review, the Department had completed its baseline or documentation of its current architecture, but the document has not been finalized or approved by the Department's Investment Review Board. The Department is beginning to develop the target or to-be architecture[8] for the future, but it does not plan to begin work on its sequencing plan until the next fiscal year.

Among the key activities that lie ahead for the Department is the development of its target enterprise architecture, which includes the collection of crucial information on its proposed business processes, strategic plans, and requirements. The Department will also need to develop and maintain a sequencing

[7] According to the Department official who completed the GAO survey, because the Department and FSA were working independently in developing separate enterprise architectures, the information provided to GAO was a departmental perspective and did not consider FSA's progress.

[8] As we reported in our final audit report (Control No. A11-C0009), dated September 30, 2002, on the Department's efforts to implement the Government Paperwork Elimination Act (GPEA), the Department has not developed a GPEA plan to determine what information processes should be prioritized for automation, which could affect development of an IT architecture.

plan to ensure the successful transition and implementation of its baseline to the target architecture. This plan would need to consider a variety of factors, such as business goals and operational priorities, sustaining operations during the transition, and anticipated management and organizational changes. Active management and trained project personnel, along with effective integration of the enterprise architecture with other enterprise life cycle processes, will be required to achieve success in using the enterprise architecture that is developed.

FSA's Status and Critical Elements Remaining

As of the date of our review, FSA had developed an initial enterprise architecture limited to FSA. FSA has completed its baseline architecture, target architecture, and the sequencing plan for transitioning from the baseline to the target architectures. In addition, FSA has developed a strategy to support its baseline and to act as the roadmap for transition to its target environment. Among the key steps that FSA needs to complete is the establishment of a program management office headed by a permanent Chief Architect to manage the development and maintenance of the enterprise architecture. FSA has recently designated a Chief Architect. These management positions are essential for ensuring that FSA's information technology investments are aligned with the enterprise architecture and optimizing the interdependencies and interrelationships among business operations and the underlying information technology that supports them.

According to CIO architect officials, FSA's architecture provides a good operational view of the enterprise, but it lacks information on the detailed framework layers, which describe all aspects of its business processes. Without the detailed framework layers, FSA's architecture risks modernization driven by technology rather than business. FSA's successful development of an enterprise architecture ultimately depends on effective integration of the enterprise architecture process with the enterprise business processes.

Another key step FSA needs to complete is the acquisition of an automated support tool to act as a repository for architecture products. FSA has been testing an automated tool but had not yet acquired one. Such a tool provides the ability to effectively create and maintain the enterprise architecture products. CIO Council guidance states that tool standardization is a cost-effective and recommended best practice, for determining architecture quality and alignment with the enterprise architecture policy from an acquisition cost perspective and for consistent interoperability of models. An automated support tool also facilitates analysis between projects within the architecture, including prioritizing efforts and tracking progress and impact on other projects, as well as, identifying possible redundancies. (See Appendix II and III for our analysis of the Department and FSA's progress, respectively, in relation to the CIO Council guidance for developing enterprise architectures.)

Sufficiently addressing remaining critical process steps as outlined in the CIO Council guidance and completing them within reasonable timeframes are crucial as the Department and FSA continue with development of their enterprise architectures.

## *Recommendations*

1.1 We recommend that both the Department CIO and FSA CIO address the remaining critical steps outlined in the CIO Council guidance and establish timeframes for completing those steps.

1.2 We also recommend that, similar to the Department, the FSA CIO

-- Select and acquire an automated support tool to act as a repository for architecture products.

-- Thoroughly develop the detailed framework layers to ensure an enterprise architecture driven by business views.

**Department Comments and OIG Response**

The Department and FSA concurred with the basic findings in the audit report. The Department and FSA provided comments regarding the current status of the enterprise architecture efforts. The combined comments state that they have taken action to address the remaining critical steps outlined in the CIO Council guidance and have established timeframes for completing those steps. According to the comments, a Program Management Plan (Plan) was completed in September 2001, and a project plan was recently prepared and distributed to the Information Management Working Group (IMWG) for review. The Plan includes milestones and a work breakdown structure that calls for the Department to have its enterprise architecture in place by September 2003. At the time of our fieldwork, the Department and FSA had not developed a project plan for addressing critical steps outlined in the CIO Council guidance and established timeframes for completing those steps. However, once the Plan is approved and finalized to address the steps outlined in the CIO Council guidance (included as Appendices II and III of this report) it could address our recommendation.

The comments state that, in June 2002, FSA selected and acquired the Popkin architecture tool to act as a repository for architecture artifacts, which is a different tool than the one the Department is using. However, at our July 2002 exit conference, FSA officials stated that they had selected the Popkin architecture tool, but had not yet acquired it. Since we have not confirmed the acquisition of the

architecture tool, we did not amend our recommendation. In addition, Department officials at the exit conference raised concerns, which we share, regarding the interoperability of the tool with the Department's tool and the additional costs of obtaining that interoperability.

The comments also state that FSA's Architecture Working Group (AWG) satisfies this element of the Maturity Model; however, FSA provided no additional information indicating the designation of the AWG as the program office responsible for overseeing architecture development efforts.

In addition, the comments indicate that the EAWG is currently working on developing detailed framework layers to ensure an enterprise architecture driven by business views. We commend this effort to address this recommendation.

## **Finding No. 2** – The Department's and FSA's IT Architectures Are Not Integrated

We found that the Department and FSA had been working independently in developing separate enterprise architectures. An enterprise architecture guides and constrains business and technological changes for an enterprise, which can be an organization, or a functional or mission area spanning more than one organization (e.g., financial management). In some cases, both organization and functional or mission area architectures are appropriate, where organizations interrelate closely, sharing functional and mission area responsibilities. The separate, non-integrated approach followed by the Department and FSA in developing an architecture is contrary to the basic principles of an information technology architecture and could prevent the Department from achieving the benefits of an enterprise architecture. In addition, OMB has expressed concern that the Department and FSA had two separate enterprise architectures underway, and that those architectures were not integrated.

According to CIO Council guidance, it is critical that enterprise architecture be derived through a "top-down" incremental approach, consistent with the hierarchical architectural views that are the building blocks of published architecture frameworks. It is equally important, according to this guidance, that the higher-level views span the entire enterprise. Only through such an approach can an organization develop enterprise-wide understanding of the interrelationships and interdependencies among business operations and supporting technology.

In July 1997, the GAO reported[9] that the Department did not have an enterprise (systems) architecture. According to the report, one of the purposes of the enterprise architecture is to ensure that systems are interoperable. Having an enterprise architecture would reduce the need for the Department to implement expensive workarounds, such as, computer programs to bridge the gap between the Department and other data providers' systems. According to GAO's report, one of the benefits of a department-wide enterprise architecture is to standardize system architecture – hardware, operating systems, application language, and data base management systems. Without systems that have the same architectural characteristics, accommodations must be made through the use of computer programs to bridge the gap between the Department and other data providers' systems by converting data into mutually recognizable formats. An enterprise architecture reduces the likelihood of inconsistent system design and development decisions, and the corresponding increased costs and performance shortfalls. Without a complete and enforced enterprise architecture, the Department runs the risk of buying and building systems that are duplicative, incompatible, or unnecessarily costly to maintain and interface. Although the 1997 GAO report specifically referred to Title IV (FSA) systems, it recommended that the Secretary of Education direct the Department's Chief Information Officer to develop a department-wide systems architecture.

In its Analytical Perspectives on the FY 2003 budget, OMB's analyses of the Department's information technology investments noted the two separate efforts underway in the Department, and stated that the *"nonintegrated approach allows for possible duplication of process, systems, and technology."* In preparing the Analytical Perspectives, OMB met with Department and FSA officials to discuss the Department's enterprise architecture efforts. OMB strongly encouraged the Department to work with FSA to develop a department-wide enterprise architecture. As a result of OMB's concerns, the Department and FSA committed to start to work together to integrate their respective IT architectures. Based on this commitment, under the Department's process improvement milestones included in the Analytical Perspectives, OMB noted that *"The agency is working to develop a single, integrated and comprehensive EA. …the Department is undertaking a major reform of the IT security and testing process and is working to fully integrate all IT into a common process for IT management."*

In its January 2002 draft of the Enterprise Architecture Program Management Plan (PMP), the Department refers to integrating the two enterprise architectures, specifically, that FSA will be included in the department-wide enterprise architecture. As of July 2002, the Department and FSA have been in contact and met three times (December 2001, January 2002, and February 2002) to discuss a high-

[9] *Student Financial Aid Information: Systems Architecture Needed To Improve Programs' Efficiency* (GAO/AIMD-97-122), July 1997.

level project plan to work toward one integrated enterprise-wide IT architecture. According to Department officials, the integration effort has been delayed due to difficulty in coming to agreement on a Memorandum of Understanding between the Department and FSA. The Department recently organized Information Management Working Group (IMWG) subcommittees with representation department-wide, one of which is tasked with overall enterprise architecture issues. Although the commitment to integrate the two architectures is a positive step towards developing a department-wide enterprise architecture, more aggressive efforts are needed. Without an integrated, department-wide enterprise architecture, the Department and FSA risk acquiring and developing systems that may not be able to communicate with other departmental systems.

## *Recommendations*

2.1 We recommend that the Department CIO and FSA CIO complete the integration of the FSA and Department architecture efforts into one department-wide architecture through the Enterprise Architecture Working Group and other related efforts.

**Department Comments and OIG Response**

The Department and FSA concurred with the basic findings of the draft audit report. Their comments stated that the Department is taking aggressive steps to incorporate FSA's previously separate enterprise architecture into the Department's enterprise architecture and that now "the term enterprise architecture . . . mean[s] the Department, including FSA, as the enterprise."

Both the Department and FSA disagreed with the recommendation to finalize a Memorandum of Understanding (MOU). The comments state that an MOU was no longer required because the recently established EAWG, a chartered subcommittee of the Information Management Working Group (IMWG), and its steering committee were accomplishing what the MOU was intended to accomplish. Based on the Department's and FSA's assertion that the EAWG is accomplishing the same objectives, we agree that a MOU is no longer warranted and have deleted the recommendation. We commend the Department and FSA for taking action and encourage both the Department and FSA to actively communicate and continue working together in developing and maintaining a department-wide enterprise architecture.

According to the Department and FSA's comments, the EAWG is focusing on specific aspects of the architecture and integration efforts. The comments state that, to date, the EAWG has developed a "Concept Operations paper, a high-level enterprise architecture design, and an integration paper." The

comments also state that the timelines for completion of joint working group activities have been developed through the Enterprise Architecture project plan and work breakdown structure, which was recently distributed to the IMWG for its review. The comments state that these recommendations should be deleted from the final report. At the time of our fieldwork, the Department and FSA had agreed to work jointly in integrating their respective enterprise architecture activities, but had yet to take action to develop a joint working group or timelines for the completion of activities. While we commend the Department and FSA for its action to date, addressing this recommendation, they have not completely integrated the separate architectures, which was the point of our recommendations under this section. We have modified the recommendations to recommend that the Department and FSA complete the integration of the architectures.

## **Finding No. 3** – Data Standardization Could Facilitate Program Performance Evaluation

Data standards are used to govern the conventions for identifying, naming, and formatting data, and are an important component of an IT architecture. Having such standards in place helps ensure that the data being collected and maintained within an organization are structured and stored so as to be accessible, understandable, and comparable across different systems, to everyone in the organization. The use of common identifiers or data naming conventions across systems is well established as an aid to data sharing and understandability.

Although GAO's 1997 report recommended that the Department establish standard reporting formats and data definitions, the Department has only partially done so. For example, neither the Department nor FSA have fully implemented the use of common identifiers for students and institutions, nor have they reached agreement on data characteristics and standards for use in department-wide system applications. Further, the Department has not established a common data dictionary[10] for departmental and FSA programs. Instead, each program uses its own data dictionary for its own system. As a result, the lack of common identifiers complicates data matching and makes it difficult to track students across programs. The lack of an integrated department-wide enterprise architecture makes it difficult for the Department and FSA to fully standardize data elements.

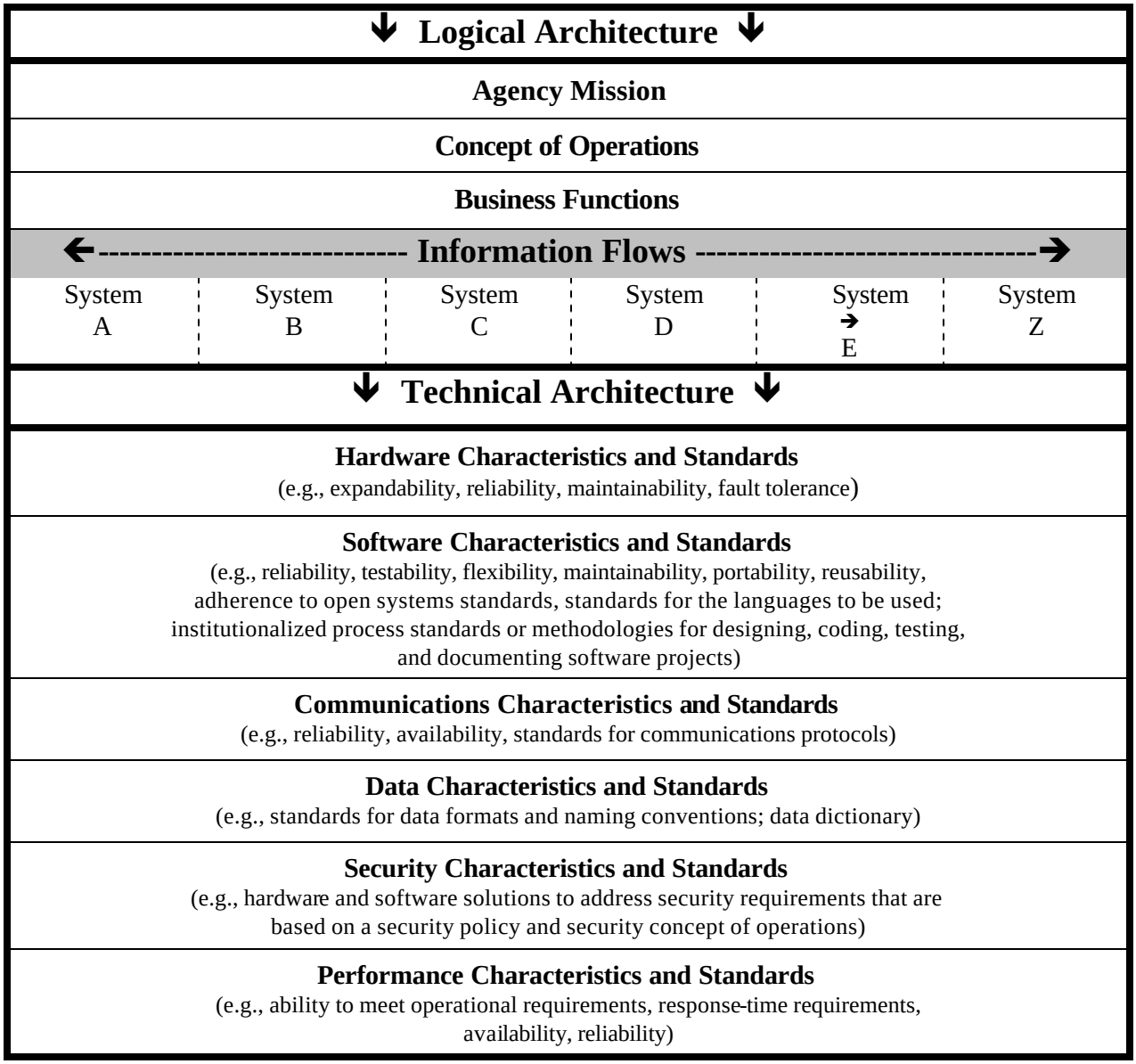
[10] A data dictionary is a repository of information describing the characteristics of data used to design, monitor, document, protect, and control data in information systems and databases.

A fully functioning enterprise architecture could resolve data standardization issues. The CIO Council's Federal Enterprise Architecture Framework highlights the importance of data standardization and states that

> *The lack of data integration due to incompatible database structures; poor quality and integrity of data; and the mixture of organizations, processes, and business rules with data, hinder data collection, manipulation, and transmission.…Data standardization, including a common vocabulary and data definition, will be difficult to achieve but is critical. A common organization eliminates redundancy and ensures data consistency.*

As depicted in Figure 3.1, an architecture guides and constrains the development and evolution of related systems in both logical and technical terms, which includes hardware and software standardization. First, the architecture logically defines the organization's functions, provides high-level descriptions of its information systems and their interrelationships, and specifies how and where information flows. Second, the architecture technically explains operational standards and characteristics for hardware, software, communications, data, security, and performance.

**Figure 3.1: Key Logical and Technical Components of a Systems Architecture System**[11]




The CIO Council's guidance on enterprise architecture emphasizes the connection between data standardization and enterprise architecture. The Council's guide – "A Practical Guide to Federal Enterprise Architecture" – states that one of the essential reasons for developing an enterprise architecture includes ensuring that

*Student Financial Aid Information: Systems Architecture Needed To Improve Programs' Efficiency* (GAO/AIMD-97-122), July 1997. OIG modified table from original format included in GAO report.

> *…the business rules are consistent across the organization, that the data and its use are immutable, interfaces and information flow are standardized, and the connectivity and interoperability are managed across the enterprise ...*

The CIO Council's guide also states that a target architecture should specify the level of interoperability needed between data sources and data users and that

> *Data, as a corporate asset, is key to an organization's vision, mission, goals, and daily work routine. The more efficiently an Agency gathers data, stores and retrieves that data, and uses the data, the more productive the Agency. Information is power.… Business processes are best improved by streamlining the flow and use of data and information.*

Currently, the Department has "stove-pipe" systems that contain information relative to each system application, but that do not match similar information in other systems. For example, according to a Department official, the Grant Accounting and Payment System (GAPS) contains financial information but not program data, so tracking specific costs crossing a number of programs to specific program goals would be difficult. In addition, different data fields with varying definitions between systems make it difficult to track the Department's performance across programs. Data standardization can facilitate the evaluation of program performance. FSA is using middleware[12] to interpret the data from different systems and convert that information into mutually recognizable formats. Although effective, the use of middleware is not an efficient alternative to data standardization and, as such, should not be considered a solution to standardization.

As stated earlier, in July 1997, GAO reported that the Department did not have an overall enterprise architecture; one aspect of developing such an architecture is data standardization. GAO recommended that the Department's CIO develop a department-wide systems architecture and ensure that it addressed systems integration, common identifiers, and data standards deficiencies. We found that little progress has been made department-wide in response to GAO's recommendations for data standardization. However, the Department has completed a business case detailing plans for standardizing departmental data in order to achieve quality and more results-based data, a document required by OMB. According to an official in the Department's Office of the Chief Information Officer (OCIO), the Department recently initiated a group to work on data standardization and that group is in the first stages of developing and implementing common identifiers.

[12] Middleware is a type of software that permits two or more incompatible applications to exchange information from different databases.

The Department has included data standardization in its action items for the Management Improvement Team (MIT) and has recently organized IMWG subcommittees with representation department-wide, one of which is tasked with data standardization issues. Specifically, the Department's Blueprint for Management Excellence states that it will certify at least 50 percent of major agency and program databases for data quality, and produce standards and guidelines for agreed-upon national education data requirements, by September 30, 2002. According to the OCIO official responsible for data standardization issues, both of these action items are in the early stages, and the database certification will likely go beyond the target date due to the large number of databases used within the Department. The official added that the group's goal is still to have a data dictionary in place by September 2002. The lack of data standards could contribute to problems with data quality and reliability, and complicate data matching, making it difficult to track students across programs.

## *Recommendation*

We recommend that the Department CIO and FSA CIO

3.1 Develop common data characteristics and standards that can be included within an enterprise architecture and from which they can develop a department-wide data dictionary.

**The Department and FSA Comments and OIG Response**

The Department and FSA concurred with the finding and agreed with our recommendation. Their comments stated that the Department is well on its way to completing a data dictionary and that EAWG has a Data Dictionary Subcommittee "…charged with developing a single enterprise data dictionary."

We believe the Department and FSA have made significant progress toward the development and completion of the dictionary and recommend that they continue to move forward to achieve the desired result. We commend both the Department and FSA for their current, on-going efforts to complete a mini-dictionary by the end of FY 2002.

## Background

Reflecting the general consensus in industry that large, complex systems development and acquisition efforts should be guided by explicit architectures, Congress passed the Clinger-Cohen Act in 1996[13] requiring Federal Agency CIOs to develop, maintain, and facilitate integrated enterprise architectures. Additionally, OMB issued guidance for agencies to follow in implementing the Act, including guidance requiring agencies to document and submit their initial enterprise architecture for OMB's review.

In March 1998, we reported[14] that the Department had not fully implemented the Clinger-Cohen Act, including not developing, maintaining, and facilitating the implementation of a sound and integrated technology architecture for the Department. Although the Department reported progress on all of the audit recommendations in the March 1998 report and expected to complete corrective actions by February 2002, not all corrective actions had been implemented at the time of our review.

Enterprise architectures are essential tools for effectively and efficiently engineering business processes and for implementing and evolving IT systems. Enterprise architectures can clarify and help optimize the interdependencies and interrelationships among an organization's business operations and the underlying information technology infrastructure and applications that support these operations. Employed in concert with other important information technology management controls, such as portfolio-based capital planning and investment control practices, enterprise architectures can greatly increase the chances that organizations' operational and information technology environments will be configured in such a way as to optimize mission performance.

Developing, implementing, and maintaining an enterprise architecture is a dynamic, iterative process of changing the enterprise over time by incorporating new business processes, new technology, and new capabilities. The development and implementation of an enterprise architecture requires sustained attention to process management and agency action over an extended period of time. Moreover, once implemented, the enterprise architecture requires regular upkeep and maintenance to ensure that it is

[13] Previously referred to as the Information Technology Management Reform Act of 1996, Division E of Public Law 104-106, 110 Stat. 679 (1996).
[14] *The Status of Education's Implementation of the Clinger-Cohen Act*, Audit Control Number 11-70007, March 1998.

kept current and accurate. Periodic reassessments are necessary to ensure that the enterprise architecture remains aligned with the Department's strategic mission and priorities, changing business practices, funding profiles, and technology innovation.

### *Guidance on Enterprise Architecture Frameworks*

In order to assist agencies in complying with the Clinger-Cohen Act requirements, the CIO Council, the Department of the Treasury, the Department of Defense, the National Institute of Standards Technology, and GAO have developed architecture frameworks or models that define the content of enterprise architectures. The CIO Council's guidance[15] provides

- A Federal framework for the content and structure of an enterprise architecture,
- A process for assessing investment compliance with an enterprise architecture, and
- A set of management controls for developing, implementing, and maintaining an enterprise architecture

The CIO Council's guidance includes an appendix detailing the Zachman Framework, which has become the *de facto* standard for enterprise architecture development. The Zachman Framework provides much of the foundation for the Federal Enterprise Architecture Framework (FEAF) and other frameworks for Federal Departments and Agencies. The CIO Council has issued guidance identifying three commonly accepted architectural frameworks[16] as candidate frameworks. These frameworks contain essential and supporting products and promote development of architectures that are complete, understandable, and integratable. Frameworks include concepts that drive the types of architecture products being created. The products, both graphical and textual, capture the information prescribed by the framework.

### *The Department's and FSA's Architecture Frameworks*

The Department and FSA are basically using the Zachman-based Framework. The Zachman Framework outlines six increasingly detailed views or levels of abstraction for six architecture descriptions. The levels of abstractions are

[15] *A Practical Guide to Federal Enterprise Architecture*, Version 1.0 (February 2001).
[16] The frameworks are: Federal Enterprise Architecture Framework (FEAF); Department of Defense (DoD) Command, Control, Communications, Computer, Intelligence, Surveillance and Reconnaissance (C4ISR) Architecture Framework; and Treasury Enterprise Architecture Framework (TEAF)

1. The Planner or Ballpark View
2. The Owner's or Enterprise Model View
3. The Designer's or Systems Model View
4. The Builder's or Technology Model View
5. The Subcontractor's or Detailed Representation View
6. The Functioning Enterprise or Actual System View

And the six architecture descriptions—and the interrogatives that they answer—are

1. The Data Description—What
2. The Function Description—How
3. The Network Description—Where
4. The People Description—Who
5. The Time Description—When
6. The Motivation Description—Why

The Department started out using the FEAF, but according to Department officials, shifted to a Zachman-based Framework because it provided a more comprehensive framework to capture all of the information about the enterprise. The FEAF, published by the CIO Council, partitions a given architecture into business, data, applications, and technology architectures. FSA's approach and concepts behind their enterprise architecture framework were also adapted from the Zachman Framework. FSA's framework lists the architecture components, such as Business Architecture, Information Technology Direction, etc., for each level of abstraction.

### *FSA as a Performance-Based Organization*

The Higher Education Amendments (HEA) of 1998 established a Performance-Based Organization (PBO) – a discrete management unit responsible for managing the operational functions supporting the programs authorized under Title IV of the HEA. The responsibilities of the PBO included integrating the information systems supporting the Federal student financial assistance programs; implementing an open, common, integrated system for the delivery of student financial assistance under Title IV; and developing and maintaining a student financial assistance system that contains complete, accurate, and timely data to ensure program integrity. In order to improve the efficiency and effectiveness of the student aid delivery system, the Amendments stated that the Secretary and the PBO Chief Operating Officer should encourage and participate in the establishment of voluntary consensus standards and requirements for the electronic transmission of information necessary for the administration of programs under Title IV.

## Objective, Scope, and Methodology

The objective of our review was to determine the status of the Department's and FSA's development of an enterprise architecture. Specifically, we determined whether (1) the Department's and FSA's enterprise architecture activities were consistent with the Federal Enterprise Architecture Framework, and (2) FSA's and the Department's architectures were compatible and interfaced with each other.

To accomplish our objective, we reviewed applicable Department and FSA policies and procedures, as well as laws, regulations, and agency guidelines addressing enterprise architectures. We obtained and reviewed the documentation of the Department and FSA's enterprise architecture. We interviewed personnel from the CIO's office within FSA, as well as, personnel in the Department's CIO office.

We also reviewed prior OIG audit reports, along with GAO reports, applicable to systems and enterprise architecture issues. We evaluated the Department and FSA enterprise architectures developed to date using the CIO Council's "A Practical Guide to Federal Enterprise Architecture" and "Federal Enterprise Architecture Framework"; and GAO's report "Enterprise Architecture Use across the Federal Government Can Be Improved". In addition, we reviewed the CIO Council's "Architecture Alignment and Assessment Guide"; and GAO's "Information Technology Investment Management Framework" for additional criteria to use in evaluating the Department's and FSA's progress in developing enterprise architectures.

We conducted work at the Department's and FSA's CIO offices in Washington, D.C. and our OIG office in Kansas City, MO, during the period October 2001 to May 2002. We held an exit conference with Department and FSA officials on July 15, 2002. Our audit was performed in accordance with government auditing standards appropriate to the scope of the review.

## Statement on Management Controls

As part of our review, we gained an understanding of the Department's management control structure applicable to the scope of this review. For purposes of this review, we assessed and classified the significant management controls related to the Department's information technology efforts into the planning and assessment activities over the Department's and FSA's development of an enterprise architecture. The assessment also included a determination of whether the processes used by FSA and the Department provided a reasonable level of assurance of compliance with the Clinger-Cohen Act of 1996.

Because of inherent limitations, and the limited nature of our review, a study and evaluation made for the limited purpose described above would not necessarily disclose all material weaknesses in the management control structure. However, our assessment identified management control weaknesses as set out in the *Audit Results* section of this report.

## **Appendix I** - General Accounting Office's Enterprise Architecture Maturity Framework

GAO's enterprise architecture maturity framework defines each of the five stages of maturity by describing the enterprise architecture management core elements associated with each stage as follows:

> ***Stage 1: Creating EA [Enterprise Architecture] Awareness*** *is characterized by either no plans to develop and use an EA, or plans and actions that do not yet demonstrate an awareness of the value of having and using one. While Stage 1 agencies may have initiated some EA core elements, these agencies' efforts are ad hoc and unstructured, and do not provide the management foundation necessary for successful EA development.*
>
> ***Stage 2: Building the EA Management Foundation*** *focuses on assignment of roles and responsibilities and establishment of plans for developing EA products. Specifically, a Stage 2 agency has designated a chief architect and established and staffed a program office responsible for EA development. Further, a steering committee or group that has responsibility for directing and overseeing the development has been established and the membership of the steering committee is comprised of business and IT representatives. At Stage 2, the agency either has plans for developing or has begun development of at least some of the necessary EA products. This stage also requires the agency to have selected both a framework that will be the basis for the nature and content of the specific products it plans to develop, and an automated tool to help in the development.*
>
> ***Stage 3: Developing Architecture Products*** *focuses on actual development of EA products. At Stage 3, the agency has defined the scope of its EA as encompassing the entire enterprise, whether organization-based or function-based, and it has a written and approved policy demonstrating institutional commitment. Although the products may not yet be complete, they are intended to describe the agency in business, data, applications, and technology terms. Further, the products are to describe the current (i.e., "as is") and future (i.e., "to be") states and the plan for transitioning from current to future state (i.e., sequencing plan). Also, as the*

*architecture products are being developed, they are to be subject to configuration control.*

***Stage 4: Completing EA Products*** *is characterized by complete and approved EA products that the agency can use to help select and control its portfolio of IT investments. The complete products describe the agency in business, data, applications, and technology terms. Also, the products are complete in that they describe the agency's current and future states and the transition plan for sequencing from the current state to the future state. Further, the agency's Chief Information Officer (CIO) has approved the EA and the agency has a written policy requiring that IT investments comply with the EA.*

***Stage 5: Leveraging the EA for Managing Change*** *entails evolving the products according to a written and approved policy for EA maintenance. Also at this stage either the steering committee, investment review board, or agency head approves the EA. Finally, the agency has incorporated the EA into its corporate decision making and has established and is using metrics to measure the effectiveness of its EA.*

The following tables summarize the Department's and FSA's progress in developing an enterprise architecture related to each stage of development included in GAO's maturity model framework.

The Department had completed, but not finalized its baseline or current architecture and is now beginning to develop the target or to-be architecture for the future. Table 1.1 compares the Department's architecture development to GAO's five-stage enterprise architecture maturity framework.

**TABLE 1.1 Status of Department's Enterprise Architecture Efforts Using GAO's Maturity Model**

| STAGE | ELEMENTS IN STAGE | ELEMENT SATISFIED |
|---|---|---|
| **Stage 1: Creating Enterprise Architecture Awareness** | Agency is aware of Enterprise Architecture. | Yes |
| **Stage 2: Building the Enterprise Architecture Management Foundation** | Committee or group representing the enterprise is responsible for directing, overseeing, and/or approving Enterprise Architecture. | Yes |
| | Program office responsible for Enterprise Architecture development exists. | Yes |
| | Chief Architect exists. | Yes |
| | Enterprise Architecture being developed using framework and automated tool. | Yes |
| | Enterprise Architecture plans call for describing enterprise in terms of business, data, applications, or technology. | Yes |
| | Enterprise Architecture plans call for describing "as is" environment, "to be" environment, or sequencing plan. | Yes |
| **Stage 3: Developing Architecture Products** | Written/approved policy exists for Enterprise Architecture development. | Yes |
| | Enterprise Architecture products are under configuration management. | No |
| | Enterprise Architecture products describe or will describe enterprise's business-and the data, applications, and technology that support it. | Yes |
| | Enterprise Architecture products describe or will describe, "as is" environment, "to be" environment, and sequencing plan. | Yes |
| | Enterprise Architecture scope is enterprise-focused. | Yes |
| **Stage 4: Completing Architecture Products** | Written/approved policy exists for information technology investment compliance with Enterprise Architecture. | Yes |
| | Enterprise Architecture products describe enterprise's business-and the data, applications, and technology that support it. | Yes |
| | Enterprise Architecture products describe "as is" environment, "to be" environment, and sequencing plan. | No |
| | Agency chief information officer has approved Enterprise Architecture. | Yes |
| **Stage 5: Leveraging the Environment Architecture for Managing Change** | Written/approved policy exists for Enterprise Architecture maintenance. | No |
| | Either Enterprise Architecture steering committee, investment review board, or agency head has approved Enterprise Architecture. | No |
| | Metrics exist for measuring Enterprise Architecture benefits. | No |

FSA has developed an initial enterprise architecture limited to FSA. Table 1.2 compares FSA's architecture development to GAO's five-stage enterprise architecture maturity framework.

**TABLE 1.2 Status of FSA's Enterprise Architecture Efforts Using GAO's Maturity Model**

| STAGE | ELEMENTS IN STAGE | ELEMENT SATISFIED |
|---|---|---|
| **Stage 1: Creating Enterprise Architecture Awareness** | Agency is aware of Enterprise Architecture. | Yes |
| **Stage 2: Building the Enterprise Architecture Management Foundation** | Committee or group representing the enterprise is responsible for directing, overseeing, and/or approving Enterprise Architecture. | Yes |
| | Program office responsible for Enterpris e Architecture development exists. | No[17] |
| | Chief Architect exists. | Yes |
| | Enterprise Architecture being developed using framework and automated tool. | Yes[18] |
| | Enterprise Architecture plans call for describing enterprise in terms of business, data, applications, or technology. | Yes |
| | Enterprise Architecture plans call for describing "as is" environment, "to be" environment, or sequencing plan. | Yes |
| **Stage 3: Developing Architecture Products** | Written/approved policy exists for Enterprise Architecture development. | Yes |
| | Enterprise Architecture products are under configuration management. | Yes |
| | Enterprise Architecture products describe or will describe enterprise's business-and the data, applications, and technology that support it. | Yes |
| | Enterprise Architecture products describe or will describe, "as is" environment, "to be" environment, and sequencing plan. | Yes |
| | Enterprise Architecture scope is enterprise-focused. | Yes |
| **Stage 4: Completing Architecture Products** | Written/approved policy exists for information technology investment compliance with Enterprise Architecture. | No |
| | Enterprise Architecture products describe enterprise's business-and the data, applications, and technology that support it. | Yes |
| | Enterprise Architecture products describe "as is" environment, "to be" environment, and sequencing plan. | Yes |
| | Agency chief information officer has approved Enterprise Architecture. | Yes |
| **Stage 5: Leveraging the Environment Architecture for Managing Change** | Written/approved policy exists for Enterprise Architecture maintenance. | No |
| | Either Enterprise Architecture steering committee, investment review board, or agency head has approved Enterprise Architecture. | No[19] |
| | Metrics exist for measuring Enterprise Architecture benefits. | No |

[17] FSA contracted with its Modernization Partner, Accenture, to form the Modernization Partner Program Management Office (PMO), which is charged with providing comprehensive program management activities focusing on the business goals of the Modernization Program, guidance, and management needed to support the delivery of all Modernization projects and initiatives. FSA's comments on the draft report contends that its Architecture Working Group (AWG) satisfies this element of the Maturity Model; however, FSA provided no additional information indicating the designation of the AWG as program office responsible for overseeing architecture development efforts.

[18] FSA used a framework to develop its enterprise architecture but still is in the process of selecting an automated support tool to act as a repository for architecture products. According to FSA's comments on the draft report, subsequent to completion of our fieldwork, it selected and acquired the Popkin architecture tool.

[19] According to an FSA official, the Deputy Secretary has not signed the last two revisions to the Modernization Blueprint.

## **Appendix II** - Analysis of Department's Progress in Completing an Enterprise Architecture Based on Steps in the CIO Council's *A Practical Guide to Federal Enterprise Architecture*

| Steps in Enterprise Architecture Development Process | Department's Progress in Steps (✓ = completed NC = Not Completed at this time) | Examples of Actions Planned/Taken by Department | Examples of Actions Still To Be Taken |
|---|---|---|---|
| **Obtain executive buy-in and support** | ✓ | | |
| Ensure agency head buy-in and support | ✓ | | |
| Issue executive enterprise architecture policy | ✓ | | |
| Obtain support from senior executive and business units | ✓ | | |
| **Establish management structure and control** | ✓ | | |
| Establish Technical Review Committee | ✓ | | |
| Establish Capital Investment Council | ✓ | | |
| Establish EA Executive Steering Committee | ✓ | | |
| Appoint Chief Architect | ✓ | | |
| Establish EA Program Management Office | ✓ | | |
| Appoint key personnel for risk management, configuration management, and quality assurance (QA) | ✓ | | |
| Establish Enterprise Architecture core team | ✓ | | |
| Develop EA marketing strategy and communications plan | ✓ | | |
| Develop EA program management plan | ✓ | | |
| Initiate development of enterprise architecture | ✓ | | |
| **Define architecture process and approach** | ✓ | | |
| Define intended use of architecture | ✓ | | |
| Define scope of architecture | ✓ | | |
| Determine depth of architecture | ✓ | | |
| Select appropriate EA products | ✓ | | |
| -- Select products that represent business of enterprise | ✓ | | |
| -- Select products that represent agency technical assets | ✓ | | |
| Evaluate and select framework | ✓ | | |

| Steps in Enterprise Architecture Development Process | Department's Progress in Steps (✓ = completed NC = Not Completed at this time) | Examples of Actions Planned/Taken by Department | Examples of Actions Still To Be Taken |
|---|---|---|---|
| Select EA toolset | ✓ | | |
| **Develop baseline enterprise architecture** | ✓ | | |
| Collect information that describes existing enterprise | ✓ | | |
| Generate products and populate EA repository | ✓ | | |
| Review, validate, and refine models | ✓ | | |
| **Develop target enterprise architecture** | NC | Phase II - ED Enterprise Architecture Target Activities - will develop the target environment. | Department CIO personnel stated that they were beginning work on the target architecture in March 2002. |
| Collect information that defines future business operations and supporting technology: | | | |
| Strategic business objectives | | | |
| Information needed to support business | | | |
| Applications to provide information | | | |
| Technology to support applications | | | |
| Generate products and populate EA repository | | | |
| Review, validate, and refine models | | | |
| **Develop sequencing plan** | NC | Phase III - Transition Plan Development - will be used to create the transition plan or roadmap for moving from the current to the target environment. | |
| Identify gaps | | | |
| Define and differentiate legacy, migration, and new systems | | | |
| Plan migration | | | |
| Approve, publish, and disseminate EA products | | | |
| **Use enterprise architecture** | NC | Phase II - ED Enterprise Architecture Target Activities - Target EA for all business functions and views will integrate FSA and external stakeholder interactions based on the integration strategies developed in Phase I. EA program management and | The Department's projected completion date for using its enterprise architecture is September 2002. |

| Steps in Enterprise Architecture Development Process | Department's Progress in Steps (✓ = completed NC = Not Completed at this time) | Examples of Actions Planned/Taken by Department | Examples of Actions Still To Be Taken |
|---|---|---|---|
| | | governance activities will continue. EA governance structures and processes will be used to review, validate and approve the target products. | |
| Integrate EA with capital planning and investment control and systems life cycle processes | | | |
| -- Train personnel | | | |
| -- Establish enforcement processes and procedures | | | |
| -- Define compliance criteria and consequences | | | |
| -- Set up integrated reviews | | | |
| Execute integrated process | | | |
| **Maintain enterprise architecture** | NC | Phases I through III will be completed by November 2002. At that point Phase IV - EA Maintenance - will begin and a more detailed plan, based on the approved EA Transition Plan, will be developed. | |
| Maintain EA as enterprise evolves | | | |
| -- Reassess EA periodically | | | |
| Manage projects to reflect reality | | | |
| -- Ensure business direction and processes reflect operations | | | |
| -- Ensure current architecture reflects system evolution | | | |
| -- Initiate new and follow-up projects | | | |
| -- Prepare proposal | | | |
| -- Align project to EA | | | |
| -- Evaluate legacy system maintenance requirements against sequencing plan | | | |
| -- Maintain sequencing plan as integrated program plan | | | |
| **Continue to consider proposals for EA modifications** | NC | Phases I through III will be completed by November 2002. At that point Phase IV - EA Maintenance - will begin and a more detailed plan, based on the approved EA Transition Plan, will be developed. | |

Source: Department of Education's Office of Inspector General's analysis of Department's enterprise architecture efforts compared to CIO Council's guidance: *A Practical Guide to Federal Enterprise Architecture*.

## **Appendix III** - Analysis of FSA's Progress in Completing an Enterprise Architecture Based on Steps in the CIO Council's *A Practical Guide to Federal Enterprise Architecture*

| Steps in Enterprise Architecture Development Process | FSA's Progress in Steps (✓ = completed NC = Not Completed at this time) | Examples of Actions Planned/Taken by FSA | Examples of Actions Still To Be Taken |
|---|---|---|---|
| **Obtain executive buy-in and support** | ✓ | | |
| Ensure agency head buy-in and support | ✓ | | |
| Issue executive enterprise architecture policy | ✓ | | |
| Obtain support from senior executive and business units | ✓ | | |
| **Establish management structure and control** | NC | | FSA has not designated an Enterprise Architecture Program Management Office. |
| Establish Technical Review Committee | ✓ | | |
| Establish Capital Investment Council | ✓ | | |
| Establish EA Executive Steering Committee | ✓ | | |
| Appoint Chief Architect | ✓ | | |
| Establish EA Program Management Office | NC | FSA has not created a Program Office for Architecture within its organization. | GAO and CIO Council guidance state formation of an enterprise architecture program management office is a best practice in developing an enterprise architecture. |
| Appoint key personnel for risk management, configuration management, and quality assurance (QA) | ✓ | | |
| Establish Enterprise Architecture core team | ✓ | | |
| Develop EA marketing strategy and communications plan | ✓ | | |
| | | | |
| Develop EA program management plan | ✓ | | |

| Steps in Enterprise Architecture Development Process | FSA's Progress in Steps (✓ = completed NC = Not Completed at this time) | Examples of Actions Planned/Taken by FSA | Examples of Actions Still To Be Taken |
|---|---|---|---|
| Initiate development of enterprise architecture | ✓ | | |
| **Define architecture process and approach** | ✓ | | |
| Define intended use of architecture | ✓ | | |
| Define scope of architecture | ✓ | | |
| Determine depth of architecture | ✓ | | |
| Select appropriate EA products | ✓ | | |
| -- Select products that represent business of enterprise | ✓ | | |
| -- Select products that represent agency technical assets | ✓ | | |
| Evaluate and select framework | ✓ | | |
| Select EA toolset | NC | FSA has tested the Ptech Framework tool, which the Department chose as its tool. | FSA still needs to adopt an enterprise architecture support tool. |
| **Develop baseline enterprise architecture** | ✓ | | |
| Collect information that describes existing enterprise | ✓ | | |
| Generate products and populate EA repository | ✓ | | |
| Review, validate, and refine models | ✓ | | |
| **Develop target enterprise architecture** | ✓ | | |
| Collect information that defines future business operations and supporting technology: | ✓ | | |
| Strategic business objectives | ✓ | | |
| Information needed to support business | ✓ | | |
| Applications to provide information | ✓ | | |
| Technology to support applications | ✓ | | |
| Generate products and populate EA repository | ✓ | FSA has tested, with the Department, the Ptech Framework tool for capturing enterprise architecture information. | FSA still needs to adopt an enterprise architecture support tool. |
| Review, validate, and refine models | ✓ | | |
| **Develop sequencing plan** | ✓ | | |
| Identify gaps | ✓ | | |
| Define and differentiate legacy, migration, and new systems | ✓ | | |
| Plan migration | ✓ | | |
| Approve, publish, and disseminate EA products | ✓ | | |

| Steps in Enterprise Architecture Development Process | FSA's Progress in Steps (✓ = completed NC = Not Completed at this time) | Examples of Actions Planned/Taken by FSA | Examples of Actions Still To Be Taken |
|---|---|---|---|
| **Use enterprise architecture** | NC | | |
| Integrate EA with capital planning and investment control and systems life cycle processes | NC | | FSA needs to finalize draft policy and guidance on the integration of its enterprise architecture with the capital planning and investment control and systems life cycle processes. |
| -- Train personnel | NC | FSA has drafted processes to provide for education of staff on architecture issues, publicity, and demonstrations of the architecture using the Architecture Support Group. This document was still in draft form as of December 2001. | |
| -- Establish enforcement processes and procedures | ✓ | | |
| -- Define compliance criteria and consequences | ✓ | | |
| -- Set up integrated reviews | ✓ | | |
| Execute integrated process | NC | FSA formulated a process and plan for integrating the architecture with the investment projects and has undertaken projects that fit within the sequencing plan for moving to the target architecture. | |
| **Maintain enterprise architecture** | NC | | FSA needs to finalize guidance and policy on management of projects and coordination with enterprise architecture. |
| Maintain EA as enterprise evolves | NC | | |

| | | | |
|---|---|---|---|
| -- Reassess EA periodically | NC | The BTA Process Guide states that the Architecture Working Group (AWG) will review FSA's future direction and its current IT architecture, and then make architectural renewal determinations. | |
| Manage projects to reflect reality | NC | Several documents are still in draft form. | |
| -- Ensure business direction and processes reflect operations | NC | FSA's BTA Process Guide outlines processes that are to be taken to ensure alignment with business processes. The BTA Phase II Business Case also outlines how FSA will ensure that IT investments support key business objectives and maintain business relevancy for technology related decisions. | |
| -- Ensure current architecture reflects system evolution | NC | Documentation states that the AWG will review FSA's future direction and its current IT architecture, and then make architectural renewal determinations. | |
| -- Evaluate legacy system maintenance requirements against sequencing plan | ✓ | | |
| -- Maintain sequencing plan as integrated program plan | ✓ | | |
| **Continue to consider proposals for EA modifications** | NC | FSA stated that its AWG will review future direction and current architecture, and then make architectural renewal determinations. | FSA needs to finalize draft policy and guidance on the Architecture Working Group and its role in the enterprise architecture process. |

Source: Department of Education's Office of Inspector General's analysis of Federal Student Aid's enterprise architecture efforts compared to CIO Council's guidance: *A Practical Guide to Federal Enterprise Architecture*.

## **Appendix IV** – Auditee Comments on the Draft Report

# MEMORANDUM

UNITED STATES DEPARTMENT OF EDUCATION

WASHINGTON, D.C. 20202-_____

TO: William Allen, Regional Inspector General for Audit
U.S. Department of Education
Office of Inspector General
10220 N. Executive Hills Blvd., Room 200
Kansas City, MO 64153

FROM: Craig B. Luigart
Chief Information Officer

James Manning
Acting Chief Operating Officer, Federal Student Aid

SUBJECT: Draft Audit Report - Audit of Enterprise Architecture
Control Number ED-OIG/A07-C0001

In response to the July 31, 2002 memorandum from Andrew Patchan, Jr., Senior Director, Systems Internal Audit Team, we are providing our written comments to you.

The Office of the Chief Information Officer (OCIO) and Federal Student Aid (FSA) concur with the basic findings of the subject draft audit report. Our comments, which follow, reflect both the OCIO and FSA responses. We offer a number of observations and a report of actions completed and planned. Some of these actions were completed at the time of or prior to your audit.

In the Executive Summary, as well as in the discussion under the first two findings, there are several statements that we think may misrepresent the status of our architecture activities and which we would like to correct or clarify.

Since February 2000, the beginning of the modernization program, FSA has had a functioning chief architect. The incumbent concurrently held the title of Deputy CIO and Chief Architect, and in May 2001 was designated the FSA Enterprise Architect. The FSA Enterprise Architect manages the FSA Business-Technology Alignment, actualized through the FSA Architecture Working Group (AWG), composed of business unit representatives and FSA CIO representatives, and the supporting FSA Architecture Support Group (ASG) that engages in examination and technical analyses of new technologies; and recommends solutions to business requirements. The FSA CIO considers this fully functioning AWG/ASG structure as its architecture program office. Projects are initially reviewed by the ASG, which makes recommendations to the AWG, which in turns makes recommendations to the FSA Decision Support Group (DSG) and then to the FSA Investment Review Board (FSA IRB). By the time investment decisions are made, a proposed investment has been fully vetted through the architecture governance structure. This process establishes the functional linkage between FSA architecture program office and the FSA capital planning and investment control process. We also have linkages, since June 2001, in the Systems Development Life Cycle to the Architecture Review Process. We believe that the Executive Summary and that the analysis of FSA's efforts using the GAO maturity model (Table 1.2) should be modified to recognize the

existence of an FSA Enterprise Architect, the existence of the FSA EA PMO office, and the integration of enterprise architecture with the capital planning and investment control and system life cycle processes.

In both the Executive Summary and in the discussions under Findings Number 1 and 2, the draft report states that the Department does not have provisions for incorporating the FSA architecture into the enterprise architecture. We believe that both the FSA and the Department architectures, although somewhat separately developed and recently becoming integrated, are business-based models. A flexible architecture has evolved, and that evolution has come about partly by design and partly by utilization of available resources. We have placed emphasis on the interoperability of our technical environments. By technical environments, we mean business processes supported by technology selected to make the business process happen. In other words, different kinds of business processes need different kinds of information technologies. The Department has focused on the relative expertise of the scope of the business served. For example, the OCIO traditionally uses its operational expertise to provide the Department's infrastructure; the Office of the Chief Financial Officer (OCFO) and FSA are financial operations and use technologies appropriate to the banking industry; the Office of Educational Research and Improvement (OERI) collects, analyzes, reports and disseminates information and uses technologies suitable for those functions. Thus, we are not centralized in one command and control-like structure, but we do have a business-oriented model that aims at maximum efficiencies in the Principal Offices and the various business areas. We have recently become aware of what we have accomplished, as we have addressed the issues in integrating the FSA architecture into the Department enterprise architecture. We recognize that we have a business-driven, flexible, and increasingly interoperable architecture.

Indeed, as we have worked together to understand the nuances of integrating our two architectures, we have integrated several architectural solutions supporting common business functions, such as electronic records management, voice over internet protocol, or financial management. We recognize that this approach conforms to the recently released Office of Management and Budget (OMB) guidance that supports the alignment of services common to lines of business as a viable enterprise architecture strategy.

The audit team visited FSA and OCIO as changes were underway, as we were incorporating the previously separate FSA enterprise architecture into the Department's enterprise architecture. Note that we now use the term enterprise architecture to mean the Department, including FSA, as the enterprise. We are taking aggressive steps to complete the incorporation, including:

- In Spring 2002, establishment of an Enterprise Architecture Working Group (EAWG), a chartered subcommittee of the Information Management Working Group (IMWG), whose membership is composed of principal officer representatives. The IMWG was established in 2000.
- Appointment of Harry Feely, FSA Deputy CIO, as the chair of the EAWG.
- Establishment of an EAWG steering committee that meets weekly or more frequently, if warranted.
- Preparation of an Executive Enterprise Architecture (in process).
- Preparation of an enterprise wide high-level security reference model (in process).
- Active incorporation of the FSA architectural standards into the enterprise architectural standards.
- FSA affirmation of the enterprise architecture principles.
- Interoperative Enterprise Architecture tools to exchange content.

We offer the following comments regarding our current status in addressing the findings and recommendations:

*Finding No. 1:* The Department and FSA are Making Progress in Developing an Enterprise Architecture but Challenges Remain.

*Recommendation 1.1:* We recommend that both the Department CIO and FSA CIO address the remaining critical steps outlined in the CIO Council guidance and establish timeframes for completing those steps.

*Response:* We completed a Program Management Plan in September 2001 that addresses this recommendation. In addition, we have prepared, under the Management Improvement Team Action 90 that calls for the Department having a robust enterprise architecture in place by September 2003, a project plan with milestones and a work breakdown structure. That project plan was recently distributed to the IMWG for a broad review.

*Recommendation 1.2:* We also recommend that, similar to the Department, the FSA CIO:

- ⇒ Select and acquire an automated support tool to act as a repository for architecture products.
- ⇒ Thoroughly develop the detailed framework layers to ensure an enterprise architecture driven by business views.

*Response:* In June 2002, FSA selected and acquired, through its partner Accenture, the Popkin architecture tool. This is not the same tool as selected and acquired by the Department, but the vendor commits to making the architecture artifacts interoperable. Prior to selecting Popkin, a mature Commercial Off The Shelf (COTS) architecture modeling and repository tool, FSA used Rational and the Internet to reposit its architecture artifacts. FSA has used various methods to maintain linkages among its architecture artifacts. Two or three years ago there were emerging tools, but none that met the full complement of requirements to warrant the time and investment of funds necessary to maintain unproven products. Both FSA and the Department evaluated, but rejected, a tool that subsequently has become OMB's tool of choice. It was available as shareware and has only recently become mature. FSA's homegrown tool was a Zachman Framework based tool used to store the early products of FSA's architecture.

The EAWG steering committee is developing framework layers to ensure that the enterprise architecture is driven by business views. It is an ED unique framework, based both on the Federal Enterprise Architecture Framework and the Zachman Framework, and we have further customized it by adding a security column.

We have not yet completed the target enterprise architecture. The One-ED initiative will be the means by which the target enterprise architecture will be defined and developed, based on reengineered business views. The Performance-Based Data Management Initiative will structure the K-12 target architecture.

Finding No. 2: The Department's and FSA's IT Architectures are Not Integrated.

In order to effectively integrate the two architectures, we recommend that the Department and FSA

*Recommendation 2.1:* Finalize a Memorandum of Understanding regarding integrating the separate architectures and hold regularly scheduled joint technical enterprise architecture meetings to discuss progress and additional actions needed.

*Response:* We disagree. We believe that the need for a Memorandum of Understanding is no longer required because what it was intended to accomplish is being done through the EAWG and its steering committee, as described above. The EAWG formally briefs the IMWG bi-monthly.

*Recommendation 2.2:* Task the architecture working group to focus on specific aspects of the architecture and integration efforts.

*Response:* This recommendation has been completed and should not be included in the final report. The EAWG is focusing on specific aspects of the architecture and integration efforts. The EAWG membership is made up of business representatives from across the Department and it meets regularly to review and prioritize integration activities. To date, it has a Concept of Operations paper, a high-level enterprise architecture design, and an integration paper.

*Recommendation 2.3:* Develop timelines for completion of joint working group activities.

*Response:* This recommendation has been completed, as described above, through the Enterprise Architecture Program Management Plan and the Enterprise Architecture project plan and work breakdown structure, and should not be included in the final report.

Finding Number 3: Data Standardization Could Facilitate Program Performance Evaluation.

We recommend that the Department and FSA

*Recommendation 3.1:* Develop common data characteristics and standards that can be included within an enterprise architecture and from which they can develop a department-wide data dictionary.

*Response:* We agree and are well on our way towards completion. This recommendation is consistent with the MIT Action 91 that calls for a K-12 data dictionary agreed upon by the department's program offices and by the states and districts that report performance data. In addition to the Enterprise Architecture Working Group, the IMWG has a Data Dictionary Subcommittee, chaired by a senior data specialist in OERI. This subcommittee is charged with developing a single enterprise data dictionary. Review analyses are underway to look at data elements, definitions and codes. The challenge recognized by all is to work out how K-12 data and post-secondary data can be integrated to provide a consistent view of the data. The same terms often have different meanings in the two environments. In many cases, the definitions for data are linked to legislation and/or specific program requirements. The Data Dictionary Subcommittee will have a mini-dictionary published by the end of FY 2002.

FSA completed Phase I of its internal Consistent Data project which was the identification of shared data elements, review of data custodianship, and alignment of FSA's data strategy with industry best practices associated with multiple terabytes of data. This was a continuation of FSA enterprise data work begun in FY 2001. The previous effort included collecting the data dictionaries of FSA systems, consolidating the information into an FSA enterprise data dictionary, and analyzing the metadata to determine the optimum approach to data standardization. FSA aligned this effort with the work of the Department's Consensus data initiative.

Table 1.2: Status of FSA's Enterprise Architecture Efforts Using GAO's Maturity Model.

The table should be modified to recognize the:

- Existence of FSA trained personnel
- Execution of an integrated process
- Training of personnel
- Maintenance of the enterprise architecture
- AWG consideration of proposals for FSA architecture modifications.

The FSA AWG/ASG, as a functioning body, chose to leave the Architecture Working Group documents in draft format as we socialized the process throughout the entire FSA organization to include contractor personnel. As new individuals were introduced to the established process, they were invited to provide comments and suggestions to help enhance the AWG/ASG process. FSA discovered that leaving the word "draft" on the document was a method of communicating that the process was open to change. Also, FSA's Enterprise Architect completed the Federal Enterprise Architecture Certification program that is endorsed by the Federal CIO Council. The FSA AWG does make architecture renewal determinations and periodically reassesses the FSA architecture.

We appreciate the professionalism of this audit and its comprehensiveness. We are particularly appreciative of the analyses of the Department's and FSA's, separate initiatives until recently, progress in completing an enterprise architecture based on steps in the CIO Council's guidance, *A Practical Guide to Federal Enterprise Architecture*.

We are confident that our current approach, working through a formally established Enterprise Architecture Working Group, will be successful in completing an integrated enterprise architecture and in governing it into the future.

cc: Andrew Patchan, Jr., ED/OIG

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