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3-1-2007

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# ANALYZING ENTERPRISE ARCHITECTURE INTEGRATION AT THE DHS USING THE ZACHMAN FRAMEWORK

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## Abstract

*This paper offers an overview of the enterprise architecture integration issues that exist currently at the Department of Homeland Security (DHS) as the result of the ongoing integration of 22 separate federal agencies, each specializing in one or more aspects of homeland security issues. This paper outlines these architecture integration challenges experienced by DHS within the Zachman framework, a well-known structure for capturing and defining an enterprise architecture, and offers future steps for DHS in designing and implementing its integrated enterprise architecture.*

**Keywords**: enterprise systems, systems integration, Zachman framework

## Introduction

Architectures are the instantiation of an organization's strategy. Technical integration through enterprise architecture is viewed as a means to achieve the overall strategic and operational objectives of an organization or a partnership of organizations. Appropriate architectures allow for meeting current, as well as projected information needs, both within and among organizations. They also allow for the successful adoption of new information processing capabilities in a cost effective and strategically aligned manner (Nezlek, Jain, & Nazareth, 1999). The goal of an integrated enterprise architecture for the DHS has been paramount from the inception of the agency. In spite of the critical importance of this goal, there are many enterprise architecture integration issues that exist currently at DHS as the result of the ongoing integration of the 22 separate federal agencies that comprise the overarching agency. This paper outlines the enterprise architecture integration challenges experienced by DHS within the Zachman framework (Zachman, 1987), a well-known structure for capturing and defining an enterprise architecture, and offers future steps for the agency in designing and implementing its integrated enterprise architecture.

## Enterprise Architecture within Federal Agencies and at DHS

Efforts at constructing enterprise architectures within US federal government agencies have been undertaken with varying degrees of success, depending upon the agency in question. There is a wide disparity in enterprise architecture integration among large agencies, where enterprise architecture would be most critical to the success of the agency's mission. Responsible for the benefits of millions of active and retired US armed services personnel and their families, the Veteran's Administration (VA) adopted an integrated enterprise architecture based on the Zachman framework in 2001, an enterprise architecture that "aligned with program/business goals that enables enterprise-wide data integration" (Veteran's Affairs Enterprise Architecture Innovation Team, 2001). The adoption

of the integrated enterprise architecture is credited with enabling the VA to successfully launch the Federated Information Technology Management System project, an agency wide initiative to modernize the agency's information systems to support future IT projects.

The VA's well-developed enterprise architecture stands in stark contrast to the enterprise architecture situation at the US Department of Defense (DoD), where the Government Accountability Office (GAO) reports that even after spending four years and $318 million trying to develop an enterprise architecture, the DoD's proposed architecture is "incomplete, inconsistent, and not integrated." (Rosencrance, 2005; US General Accounting Office, 2001) The GAO points out that undertaking any large scale systems modernization program is likely to fail without a well-defined enterprise architecture and continues to recommend that the DoD develop and adopt an enterprise architecture based on a framework (e.g. the Zachman framework) to proceed in modernizing the information systems of the agency (US Government Accountability Office, 2005).

From the enterprise architecture scenarios at the VA and the DoD, we can surmise that while federal government agencies are aware that a well-defined, integrated enterprise architecture is necessary for IS modernization and actively advocate this position, the design and implementation of such an architecture can be difficult and daunting. The enterprise architecture integration scenario at DHS presents a slightly different challenge than that at the VA or DoD, as the enterprise architecture of DHS is based on the architectures embedded within 22 separate federal agencies, all of which were combined to form DHS in early 2003. As a result of this very recent agency aggregation, the enterprise architecture of DHS will be much more inter-organizational in nature than intra-organizational, as the VA's and DoD's are. Fortunately, at the genesis of the DHS' founding, it was determined that an integrated enterprise architecture would be essential to the agency's future effectiveness.

The GAO reported in August 2004 that the key elements of the enterprise architecture that are present in the initial version developed by DHS were not derived by adhering to a strategic plan and outlined in an enterprise architecture framework, as would be prescribed by best practices. Instead, the threads of the enterprise architecture present were based on assumptions about a DHS strategy and are largely the products of combining the existing architectures of several of the department's predecessor agencies, along with their respective portfolios of system investment projects. As a result, DHS does not yet have the necessary enterprise technology architectural blueprint to effectively guide and constrain its ongoing operational IT transformation efforts and the hundreds of millions of dollars that the agency is currently investing in supporting IT assets (US Government Accountability Office, 2004). The aim of this paper is to show that by developing an integrated enterprise architecture based on a standard framework, such as the Zachman framework, as opposed to developing a patchwork integration plan for all of the existing enterprise systems, DHS can implement a well-defined, robust enterprise architecture that will optimize its future strategic and operational outcomes.


## *The Zachman Framework*

One of the most widely known frameworks in the context of enterprise architecture (Pereira & Sousa, 2004), the Zachman framework was published as a matrix that offers a taxonomy for information entities, identifying two different axes of representations describing the nature and purpose of each cell in the taxonomy and the deliverables within the organizational context (Mrdalj & Jovanovic, 2005). The Zachman framework is a general purpose enterprise architecture framework that does not impose a method, methodology or a pre-defined set of artifacts on its adopters (Pereira & Sousa, 2004). Its overarching goal is to provide a means of ensuring that standards for creating the enterprise architecture exist and that they are appropriately integrated (Sowa & Zachman, 1992). The taxonomy, shown in Figure 1 below, provides an organization for the representations of an enterprise, taking into consideration all of the stakeholders involved in the planning, conception, building, using and maintaining of activities involved in an enterprise information system. While each cell of the framework is "normalized" with one fact in one place (Zachman, 1987), all of the descriptions pertain to the same system, and therefore, are related to one another. The Zachman framework has been used in the past in enterprise architecture planning and as the basis for building enterprise architectures (Cook, 1996; Spewak & Hill, 1993).

**Figure 1. The Zachman Enterprise Architecture Framework (Based upon: www.zifa.com/framework.html)**

| Zachman Framework | Data (What) | Function (How) | Network (Where) | People (Who) | Time (When) | Motivation (Why) |
|---|---|---|---|---|---|---|
| Scope (Contextual) | List of things important to the enterprise | List of core processes the business performs | List of locations in which the business operates | List of organizations important to the business | List of events/cycles significant to the business | List of business goals/ strategies |
| Enterprise Model (Conceptual) | e.g. Semantic model<br><br>Business entity Business relationship | e.g. Business process model<br><br>Business process Business resources | e.g. Business Logistics system<br><br>Business location Business linkage | e.g. Workflow model<br><br>Organization unit Work product | e.g. Master schedule<br><br>Business event Business cycle | e.g. Business plan<br><br>Business objectives Business strategy |
| System Model (Logical) | e.g. Logical data model<br><br>Data entity Data relationship | e.g. Application architecture<br><br>Application function User views | e.g. Distributed system architecture<br><br>I/S function Line characteristics | e.g. Human interface architecture<br><br>Role Deliverable | e.g. Process structure<br><br>System event Processing cycle | e.g. Business rule model<br><br>Structured assertion Action assertion |
| Technology Model (Physical) | e.g. Data Definition<br><br>Segment/Table Pointer/Key/etc. | e.g. Program<br><br>Computer function Data element /set | e.g. Technology architecture Hdw/ System structure Line specification | e.g. Presentation Architecture<br><br>User Screen Formats | e.g. Control Structure<br><br>Execute Component cycle | e.g. Rule design<br><br>Condition Action |
| Detailed Model (Out of Context) | e.g. Physical storage design<br><br>Field Address | e.g. Detailed program design Language statement Control Block | e.g. Network architecture<br><br>Address Protocol | e.g. Security architecture<br><br>Identity Job | e.g. Timing definitions<br><br>Interrupt Machine cycle | e.g. Rule specification<br><br>Sub-condition Step |
| Functioning Enterprise | *Data* | *Function* | *Network* | *Organization* | *Schedule* | *Strategy* |

## DHS's Efforts to Develop Enterprise Architecture within a Standard Framework

Since developing enterprise architecture at the agency level is a long term, critical goal, DHS has decided to begin the process by focusing on the first two (Contextual and Conceptual) rows of Zachman's framework and has issued version 1.0 of its enterprise architecture framework. Using the enterprise architecture management maturity framework (EAMMF), the GAO assessed that DHS's enterprise architecture integration efforts are at stage three (out of five stages), indicating that DHS has created awareness and has laid the foundations necessary to develop the enterprise architecture. However, the current proposed structure provides only a partial foundation upon which the future versions of the enterprise architecture can be built. The following table shows the top two rows of Zachman framework with a specific description of DHS's enterprise architecture integration efforts:

**Figure 2: The Current DHS Enterprise Architecture Proposal Mapped into Zachman's Framework**

| Zachman Framework | Data (What) | Function (How) | Network (Where) | People (Who) | Time (When) | Motivation (Why) |
|---|---|---|---|---|---|---|
| Scope (Contextual) | - closely tied to the strategy and overall mission of DHS<br><br>- these aspects *only partially discussed* due to lack of the overall DHS strategy at the time of this report | - only a high level list of core processes the business performs are identified<br><br>- *no decomposition to the operational level* | - *no list of locations* in which the business operates (including ops activities, org roles and ops events which require conformation to the existing regulatory policies and procedures) | - list of organizations important to the business *only partially been mentioned* | - list of events/cycles significant to the business *not mentioned* | - has only consolidated the strategic goals of 22 disparate intelligence divisions (only beginning to create its own strategy) |
| Enterprise Model (Conceptual) | - matches to the Federal Enterprise Architecture semantically<br><br>- discusses existing business processes, rules and relationships.<br><br>- *does not discuss the future business processes, rules and relationships.* | - *does not highlight the available opportunities* to revise and modify the existing business processes, functions and activities.<br><br>- *does NOT contain any lists of core business processes* and how these business processes are supported for DHS's overall mission and vision. | - *no evidence that logistical operations and their support systems are outlined.* | - *has not described any business process or work flows* among DHS internal stakeholders and external stakeholders<br><br>- does not reflect either the "as is" work flows or "to be" work flows<br><br>- *business processes have not decomposed in detail;* therefore, the consequential breakdown of these processes into work flow is impossible. | - *did not list any events/ cycles significant to the business processes* | - enlists only partially the high level strategy to implement the enterprise architecture.<br><br>- *does not have change management strategy, data management and conversion strategy,* etc. |

As can be seen from the above table, the scope (contextual) aspect of the enterprise architecture integration efforts at DHS has been partially completed. Of the six perspectives, fractional work has been done in the "function"

perspectives. Much work needed to be done from the perspectives of data, network, people, time and motivation, the remaining dimensions necessary to create a comprehensive, integrated enterprise architecture. Additionally, the scope of the enterprise architecture integration at DHS needs to be aligned with any overall agency strategy that DHS decides to implement at a later date.

As a result of the scope of the enterprise architecture at DHS being incomplete, the enterprise (conceptual) aspect of the framework has not been fully developed. Hence, all the six perspectives within the enterprise model have not been clearly laid out in reference to the existing and future business processes, rules and relationships. It can be summarized that the efforts of DHS to create an enterprise-wide information technology architecture framework using the first two rows of the Zachman framework is a good starting point. But it can be seen from the above analysis that much work remains to be done before the actual implementation and transition from the existing state of enterprise architecture to the future and desirable state of enterprise architecture.

## Conclusion

Both the academic literature and practitioners' experiences have indicated in the past that the development and successful implementation of enterprise-wide information technology architecture is time consuming and demands lot of commitment from every stakeholder within the company or the agency. Some of the challenges that DHS is facing in its enterprise architecture integration efforts include, but not limited to, the following: understanding of the existing as well as future business processes, business rules, policies and procedures that would complement DHS's efforts to fulfill its mission; having the ability to adapt to the dynamic requirements of an critical federal government department like DHS in face of changing global politics and insurgency activities; and having the dexterity and compatibility of the systems and technology to be able to provide DHS a decisive edge over the people from DHS needs to protect America.

Based on these findings, DHS should continue to build its enterprise architecture based on the Zachman framework by solidifying the defined scope of the enterprise architecture integration and continuing to develop the enterprise architecture's conceptual model. The agency should subsequently continue to develop its architecture by specifying a detailed logical and physical model of the architecture, which would enable DHS to bring the planned enterprise architecture into production. DHS should take caution not to continue to combine the existing architectures present in its constituent agencies into an overarching architecture for the new agency without a clear strategy as to how each architecture will ft its new overall strategy.

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