contemporary issues

Enterprise Architecture: Origins, Tools, and Insights
Transforming Army Supply Chains: an Analytical Architecture for Management Innovation
Leaning the DoD Supply Chain: the DoD Activity Address Code

Contemporary Issues in this edition presents three articles: "Enterprise Architecture: Origins, Tools, and Insights," "Transforming Army Supply Chains: an Analytical Architecture for Management Innovation" and "Leaning the DoD Supply Chain: the DoD Activity Address Code."

In "Enterprise Architecture: Origins, Tools, and Insights" Captain Alice Marie Long, USAF, discusses enterprise architecture (EA), how it works, and most importantly, why it is needed. She also presents guidelines for implementation of EA, along with a synopsis of possible pitfalls in EA development.

Colonel Greg H. Parlier, PhD, USA, Retired, in "Transforming Army Supply Chains: an Analytical Architecture for Management Innovation" describes a practical approach for understanding the Army's extremely complex logistics system by introducing a systems framework which is guiding an ongoing project addressing major challenges confronting logistics transformation. The project focus is on inventory management policy prescriptions illuminated through the prism of an enterprise-wide supply chain analysis.

In the concluding article, Jay Barber, Global Logistics Support Center, USAF; Michael Werneke, Global Logistics Support Center, USAF; and Kevin P. Duffy, PhD, Wright State University, examine the efforts to introduce Lean to the Department of Defense (DoD) supply chain. A survey conducted by Manrodt, Vitasek and Thompson discovered that although Lean principles and concepts are being applied to the supply chain across numerous organizations, these principles are slow to be adopted in nonmanufacturing organizational settings. Importantly, the DoD is seen as an enormous organization, and an organization which is steeped in the traditional: the DoD encompasses ways of doing things which apply to supplier selection, organizational processes, and rigid hierarchical chains of command. Thus, the implementation of Lean principles into the DoD supply chain provides an extraordinary opportunity to examine a Lean implementation from two different perspectives. The first is that of applying Lean to a nonmanufacturing organization. The second perspective is to view attempts to implement Lean in a rigid organizational setting.

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Enterprise Architecture: Origins, Tools, and Insights

Alice Marie Long, Captain, USAF

Introduction

The Air Force is continually taking measures to institutionalize enterprise architecture (EA). However, many in the Air Force have a limited concept of what an EA is, how it works, and most importantly, why it is needed. The purpose of this article is to discuss these key questions, to present some guidelines for implementation of EA, and make the reader aware of some of the possible pitfalls of EA development.

To begin a discussion of enterprise architecture, it is important to first obtain an understanding of architecture in general. Architecture is the structure of components, their relationships, and the principles and guidelines governing their design and evolution over time.[1] Architecture is known to be essential when considering the design of a new building or a community; however, architecture is equally necessary when considering the design and creation of complex systems within organizations. Whether a new community is being planned or a business is expanding, several of the same issues must be considered: integrated services, interoperable systems, and efficient operations. The end objective of architecture is the alignment of components under common standards that facilitate change management and ensure integrated and effective operation.

The concept of architecture is comparable at the enterprise level. The Federal Chief Information Officers (CIO) Council regards an enterprise as an organization supporting a defined business scope and mission and comprised of interdependent resources (people, organizations, and technology) who must coordinate their functions and share information in support of a common mission (or set of related missions).[2] Enterprises exist within commercial businesses and industry, private institutions, as well as in areas of governance. Governmental enterprises are unique because their purpose is not the generation of revenue. These organizations are concerned primarily with the maintenance of basic security and public order. Nevertheless, the federal government is a single enterprise with shared strategic objectives, a common authority structure, integrated management processes, and consistent policies. As is the case in other enterprises, the goal is to optimize resource allocations across the organization to achieve common goals, whether at the local or national level.[3]

Legislation

Aside from simply being a good tool for business, architecture within the government has been mandated by legislation. In 1996, the *Clinger-Cohen Act* (CCA) was established to improve the way the federal government acquires and manages information technology (IT). The idea was that acquisition, planning, and management of technology should be treated as a capital investment, exactly as a profitable business would be operated. The CCA directs

all federal agencies to establish a comprehensive approach to manage the acquisition, use, and disposal of IT. Though architecture is not prescribed by name in the CCA, it does promote a coordinated, interoperable, secure, and shared governmental infrastructure.[4] A legislative measure that formally mandates the development of architecture for government programs is described in Circular A-130, *Management of Federal Information Resources*. This publication prescribes the development and maintenance of an enterprise architecture to promote the appropriate application of federal information resources.[5] This mandate is intended to establish capital planning and investment control processes that link mission needs, information, and IT in an effective and efficient way. The circular also establishes architecture as *grading* criteria for acquisition of new systems. In that, architecture is used for the certification of any federal business system modernization effort that exceeds $1M.[6]

One of the most significant Department of Defense (DoD) level instructions is Chairman of the Joint Chiefs of Staff Instruction 3170.01, *Joint Capabilities Integration and Development System* (JCIDS). JCIDS is intended to identify shortfalls and redundancies in national defense and to develop solutions (materiel and nonmateriel) through a joint collaboration using integrated architectures among the Services. The focus is to resolve military capability gaps with solutions that are *born Joint* with architecting consideration given to uses across the spectrum, not a single Service or mission area. The future state of JCIDS implementation is fully integrated defense networks that eliminate waste and optimize system usage.[7] There are several other DoD directives governing the use of architecture, but at the Air Force level, enterprise architecture is prescribed in Air Force Policy Directive 33-4, *Enterprise Architecting*. The directive assigns architecture development and management, a governance process, as well as the establishment of a repository for architecture products. The Air Force enterprise architecture is to be used as a decision support tool, and guide all IT and National Security System investments.[8]

Article Acronyms

ACE – Automated Commercial Environment
ADM – Architecture Development Method
AF EAF – Air Force Enterprise Architecture Framework
AFEA – Air Force Enterprise Architecture
AFI – Air Force Instruction
AFLMA – Air Force Logistics Management Agency
AV – All Views
BRM – Business Reference Model
C4ISR – Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
CBP – Customs and Border Protection
CCA – Clinger-Cohen Act
CEA – Chief Enterprise Architect
CJCSI – Chairman Joint Chiefs of Staff Instruction
DoD – Department of Defense
DoDAF – Department of Defense Architecture Framework
DRM – Data Reference Model
EA – Enterprise Architecture
EAF – Expeditionary Aerospace Forces
eLog-21 – Expeditionary Logistics for the 21st Century
FDA – Food and Drug Administration
FEA – Federal Enterprise Architecture
GAO – General Accountability Office
HHS – Health and Human Services (Department of)
IT – Information Technology
JCIDS – Joint Capabilities Integration and Development System
LogEA – Logistics Enterprise Architecture
MAJCOM – Major Command
OV – Operational View
PRM – Performance Reference Model
SRM – Service Component Reference Model
SV – Systems/Services View
TAFIM – Technical Architecture Framework for Information Management
TAG – Technology and Architecture Group
TEAF – Treasury Enterprise Architecture Framework
TOGAF – The Open Group Architecture Framework
TRM – Technical Reference Model
TV – Technical View

Architecture Frameworks

To facilitate the completion of required architecture, a framework is necessary. A framework addresses architecture components, such as methodology, product descriptions, reference models, categorization, and classification. An overview of the most common architecture frameworks follows.

The Zachman Framework

One of the first and best known standards for classifying the descriptive models that comprise enterprise architecture is the Zachman Framework. This methodology was based on the belief that a common architectural schema could be used to represent any complex entity. It is depicted as a grid (see Figure 1) that consists of six functional focuses (columns), and then considers those focuses from the perspectives of the stakeholders (rows). The Zachman Framework does not prescribe a particular architecting methodology, and is used to categorize primitive enterprise architecture information. However, the tool can be used to organize data on the enterprise, to define which artifacts to produce and to describe processes.[9] Zachman applied to the Air Force logistics enterprise would include an organization chart to define the high level *who* portion of the framework. At a lower level would be a description of the physical data resident in the logistics enterprise. This framework would be helpful in defining and describing processes associated with the logistics enterprise and provide a good way to determine which artifacts are necessary to model the system.

The Open Group Architecture Framework

Another framework that provides a detailed comprehensive approach to design, planning, and implementation of architecture is The Open Group Architecture Framework (TOGAF). TOGAF is designed to support four common subsets of an overall enterprise architecture: business architecture, data architecture, application architecture, and technology

	What	How	Where	Who	When	Why	
Scope	Inventory Identification: Inventory Types	Process Identification: Process Types	Network Identification: Network Types	Organization Identification: Organization Types	Timing Identification: Timing Types	Motivation Identification: Motivation Types	Strategies
Business	Inventory Definition: Bus. Entity Bus. Relation	Process Definition: Bus. Transform Bus. Input	Network Definition: Bus. Location Bus, Connect	Organization Definition: Bus. Role Bus. Work	Timing Definition: Bus. Cycle Bus. Moment	Motivation Definition: Bus. End Bus. Means	Executive Leaders
System	Inventory Representation Sys. Entity Sys. Relation	Process Representation Sys. Transform Sys. Input	Network Representation Sys. Location Sys. Connect	Organization Representation Sys. Role Sys. Work	Timing Representation Sys. Cycle Sys. Moment	Motivation Representation Sys. End Sys. Means	Architects
Technology	Inventory Specification: Tech. Entity Tech. Relation	Process Specification: Tech. Transform Tech. Input	Network Specification: Tech. Location Tech. Connect	Organization Specification: Tech. Role Tech. Work	Timing Specification: Tech. Cycle Tech. Movement	Motivation Specification: Tech. End Tech. Means	Engineers
Component	Inventory Configuration: Comp. Entity Comp. Relation	Process Configuration: Comp. Transform Comp. Input	Network Configuration: Comp. Location Comp. Connect	Organization Configuration: Comp. Role Comp. Work	Timing Configuration: Comp. Cycle Comp. Moment	Motivation Configuration: Comp. End Comp. Means	Technicians
Operations	Inventory Instantiation: Ops. Entity Ops. Relation	Process Instantiation: Ops. Transform Ops. Input	Network Instantiation: Ops. Location Ops. Connect	Organization Instantiation: Ops. Role Ops. Work	Timing Instantiation: Ops. Cycle Ops. Movement	Motivation Instantiation: Ops. End Ops. Means	Workers
	Inventory	Process	Network	Organization	Timing	Motivation	

Figure 1. Zachman Enterprise Architecture Framework

architecture. This method originated from the Technical Architecture Framework for Information Management developed by DoD. TOGAF is an architectural process that can be used to complement Zachman's taxonomical approach. Like Zachman, however, TOGAF does not prescribe architecture products, but instead promotes an architecture development method (ADM) that gives guidelines for architecting. The stages of the development cycle outlined in the ADM provide guidance to the architect. These phases are further decomposed into steps. The ADM cycle is an iterative process, requiring frequent validation of results against the original expectations.[10]

The Federal Enterprise Architecture

A third architecture framework is tailored to a more specific enterprise; the federal government. The federal enterprise architecture (FEA) is a business approach aimed at developing a more customer focused government that simplifies processes and unifies efforts across agencies. The FEA has evolved from its original form, with significant changes occurring in 2007 and 2008. Currently, three core principles guide the strategic direction of the FEA: the federal enterprise must be business driven, proactive, and collaborative across the federal government; and the architecture must improve the effectiveness and efficiency of government information resources (see Figure 2).[11]

The FEA is comprised of an interrelated set of five reference models, all focused on developing a common language for the enterprise. The first model is the Performance Reference Model (PRM). The PRM is a performance measurement focused on the business of government at a strategic level and assesses the impact of IT investments at this level. It is designed to show the link between inputs and outputs, as well as to identify the practices of effective and efficient organizations within the enterprise. This type of analysis facilitates decisionmaking regarding resource allocation.

The next model is the Business Reference Model (BRM). This model facilitates a functional view of the enterprise rather than an organizational one. Standard business capabilities are identified without regard to what agency is completing them, and a business functions view is defined. The importance of this model lies in proper implementation. The BRM must be incorporated into the architectures and management processes of governmental agencies in order to help accomplish strategic goals of the enterprise.[11]

The Service Component Reference Model (SRM) is a business driven, functional framework used to classify individual service components according to how they support both the performance and business objectives. The SRM helps to recommend service capabilities that will maximize reuse of business and technical capabilities. The Technical Reference Model is a component-

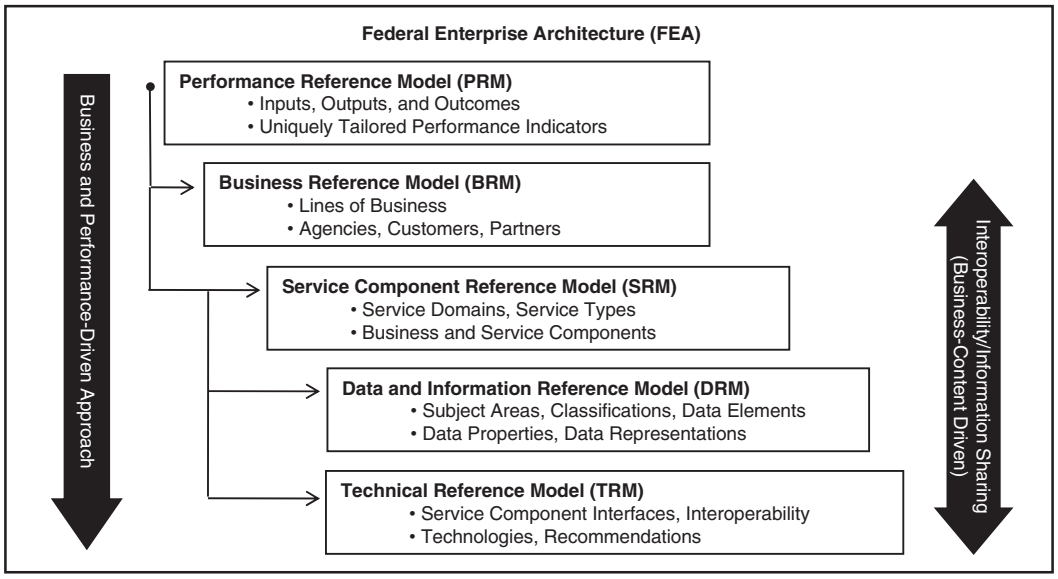

Figure 2. FEA Reference Models

driven model that categorizes standards and technologies. Again, the focus is to identify and reuse the best solutions.

Finally, the Data Reference Model (DRM) is a more flexible, standards-based model that facilitates information sharing among government agencies. The DRM objective is the standardization of data management processes across federal, state, and local organizations as necessary to enable the repeatability of the best processes across agencies by establishing a common language. In support of this objective, DRM contains three standardization areas: data description, data context, and data sharing.[11]

Another issue critical to FEA is the measurement of success. Federal agencies are rated in three main capability areas: completion, use, and results. The completion capability area measures the completion maturity of an EA's artifacts with respect to performance, business data, services, and technology. The enterprise's architectures should be well-defined and show traceability among the layers of architecture and artifacts. The use capability area deals with the actual implementation and use of the architecture as it measures the policies and procedures necessary for an organization to develop and manage its EA. The results capability area measures the effectiveness and value of the EA by assigning performance measurements to the EA processes and using these measures to complete analysis of the architecture. The results of this analysis are used to update practices and guidance for the EA. Following measurement in each of these three areas, agencies are assigned a *success rating* based on a green, yellow, and red coding system.[12]

DoD Architecture Federation

Figure 3 depicts the architecture federation of the federal government as it pertains to the Air Force specifically. It is relevant to note the horizontal portions of Figure 3. Each Air Force component is broken down into three subenterprises: agile combat support, warfighting, and infrastructure. The Air Force decomposition is further depicted in Figure 4, showing several mission and major command (MAJCOM) architectures. The Air Force Logistics Enterprise (LogEA) is a subenterprise of the agile combat support mission, and evaluation of the LogEA architecture products is one of the newly chartered mission areas of the Air Force Logistics Management Agency (AFLMA). The AFLMA is charged by A4I (Directorate of Transformation) with guaranteeing compliance of architecture to prescribed standards, and eventual management of the LogEA.

Air Force Enterprise Architecture and the DoD Architecture Framework

The vertical columns of the Federal Architecture Federation depict the guidance setting architecture requirements for the DoD and the individual military services. As seen here, the Air Force has its own enterprise architecture framework (AF EAF). The AF EAF uses the same reference models as the DoD's FEA, but provides context focused on Air Force strategy and missions. The correlation between the FEA and the AFEA is illustrated in Figure 4.

AFPD 33-04 establishes the AFEA as the method for managing change and understanding complexity in the Air Force environment. The AFEA is ultimately intended to act as a tool to aid in decisionmaking through supporting key decisionmaking processes (capabilities based planning and analysis; planning, programming, budgeting, and execution; acquisitions; and portfolio management), and guiding all IT and National Security Systems investments. Additionally, the AFEA assigns responsibility for the development, evolution, and management of the EA, and institutes a governance process. Air Force MAJCOMs directed to establish enterprise architectures must institute policies, procedures, and guidelines for architecture activities, appoint an architect, and develop and maintain architecture products. Throughout this process these products must be approved and certified as prescribed in Air Force Instruction 33-401, *Implementing Air Force Architectures.*

It was determined by the Defense Science Board that one of the key means for ensuring military systems are interoperable and effective is to establish comprehensive architecture guidance for the entire DoD.[13] The Department of Defense architecture framework (DoDAF) was developed to give direction as to how architecture products should be developed.

The DoDAF is an evolution of the Air Force command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) architecture framework which originally addressed the interoperability of C4ISR specific capabilities. It consists of three volumes. Volume I offers a general overview of the DoD architecture concept and provides guidance for the development and management of DoD architectures. Volume II delves more deeply into the concept, outlining the specific details for the individual framework products. Finally, Volume III shifts in focus to the data for architecture and its uses. The overarching DoDAF structure is organized into four unique views: all (AV), operational (OV), systems/services (SV), and technical standards (TV). The

architecture products associated with each of these views serve specific purposes.

The OV captures the operational nodes of an architecture, their tasks and activities, and interactions and information exchanges required to accomplish DoD operational concepts. The SVs outline the physical systems, required system functionality, and their data exchanges for supporting the operational views. As the architecture matures, the TVs are needed to communicate standards, protocols, technologies, and interfaces to ensure the system will satisfy its operational requirements. Though not depicted in the graphic below, the AV represents aspects of the architecture related to all three views. While the AV products don't present a distinct view of the architecture, they provide information relevant to the architecture as a whole (see Figure 5).[13]

The architectural products outlined in the DoDAF flow naturally from the reference models contained in the FEA, and subsequently the AFEA. The relationship between the AFEA and DoDAF is seen in the developing Air Force LogEA. One of the DoDAF architectural models representing the Performance Reference Model is the AV-1. In LogEA, this product acts as a concept of operations, providing strategic level information including assumptions, constraints, and limitations of the logistics enterprise. Representations of the Business Reference Model are the OV-5 activity models. The OV-5 describes the operations that are generally conducted in the course of executing the logistics mission. The DoD Supply Chain Material Management Regulation 4140.1 outlines the primary activities resident in the logistics enterprise high-level OV-5; Plan, Source, Make, Deliver, and Return. All lower level activities in the logistics supply chain result from decompositions of these key activities. The Air Force Systems/Service Component Reference Model is represented in the DoDAF SVs. For LogEA, the Systems/Services views are resident in the Expeditionary Combat Support System—the system that supports the logistics supply chain.

Observations and Case Studies

The frameworks presented here employ different approaches to architecture. While each method has its own focus, some frameworks could be used in complementary ways, and the combination of methodologies can result in synergistic effects. For example, TOGAF describes how to architect. Products outlined in the DoDAF could be employed to document the architecture decisions made in TOGAF methodology. The Zachman Framework can be used to check for completeness in architectural elements and to determine whether or not processes are sufficiently examined. This type of combination often provides a better result than attempting to fit everything into a single framework. The important issue is to find the method (or methods) that works well within the organization's goals and

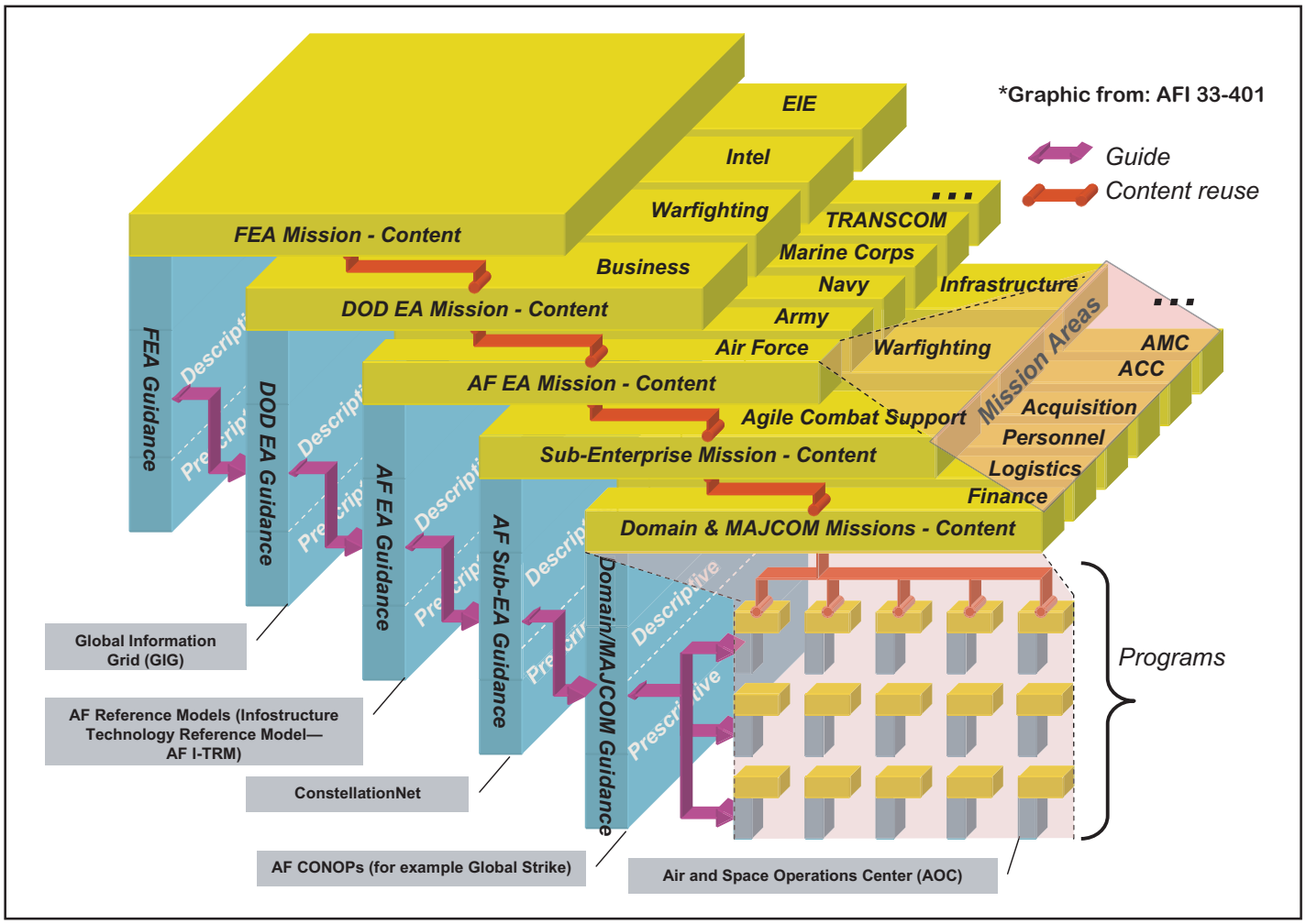

Figure 3. Federal Architecture Federation

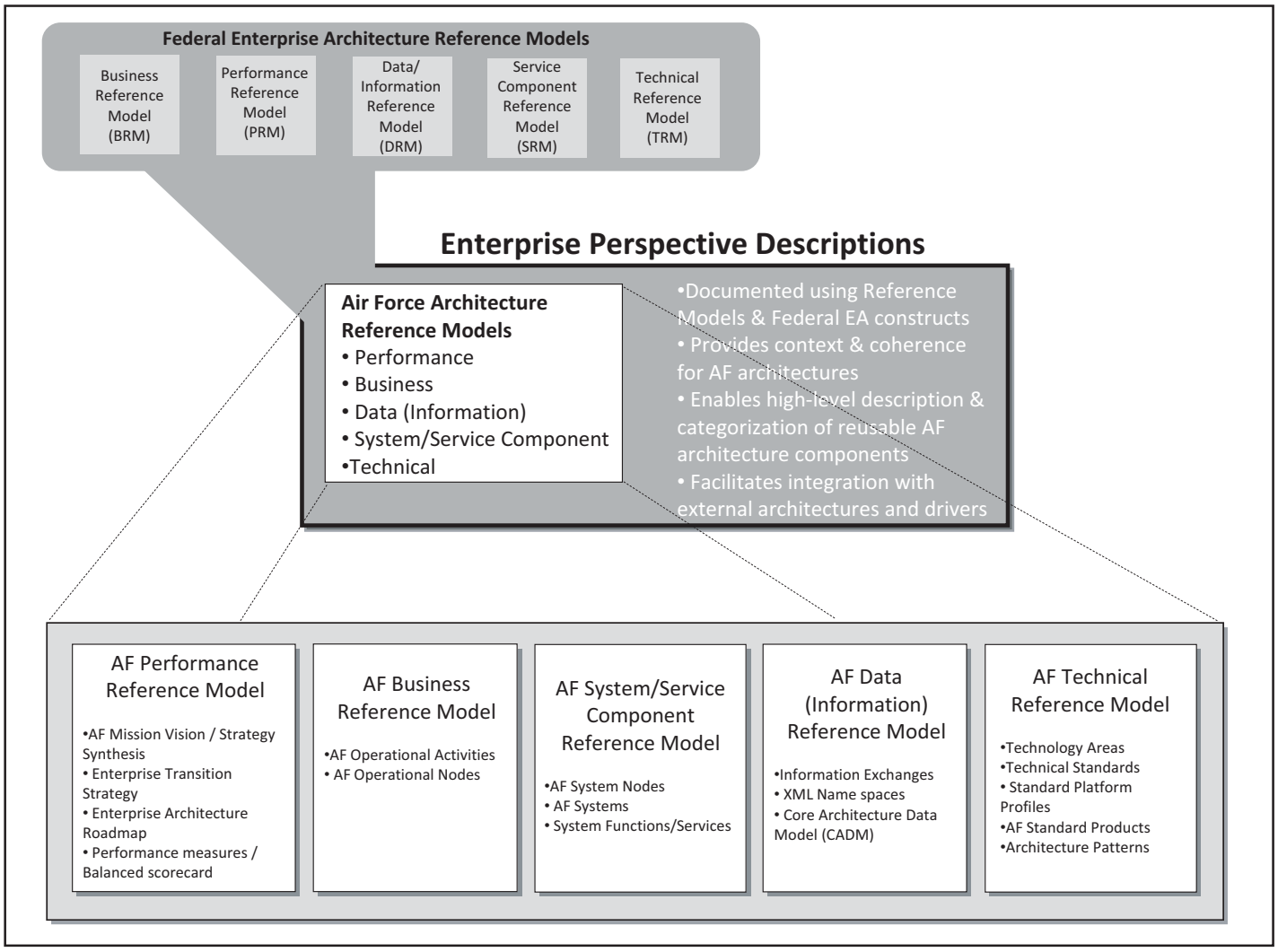

Figure 4. Air Force Enterprise Architecture Framework

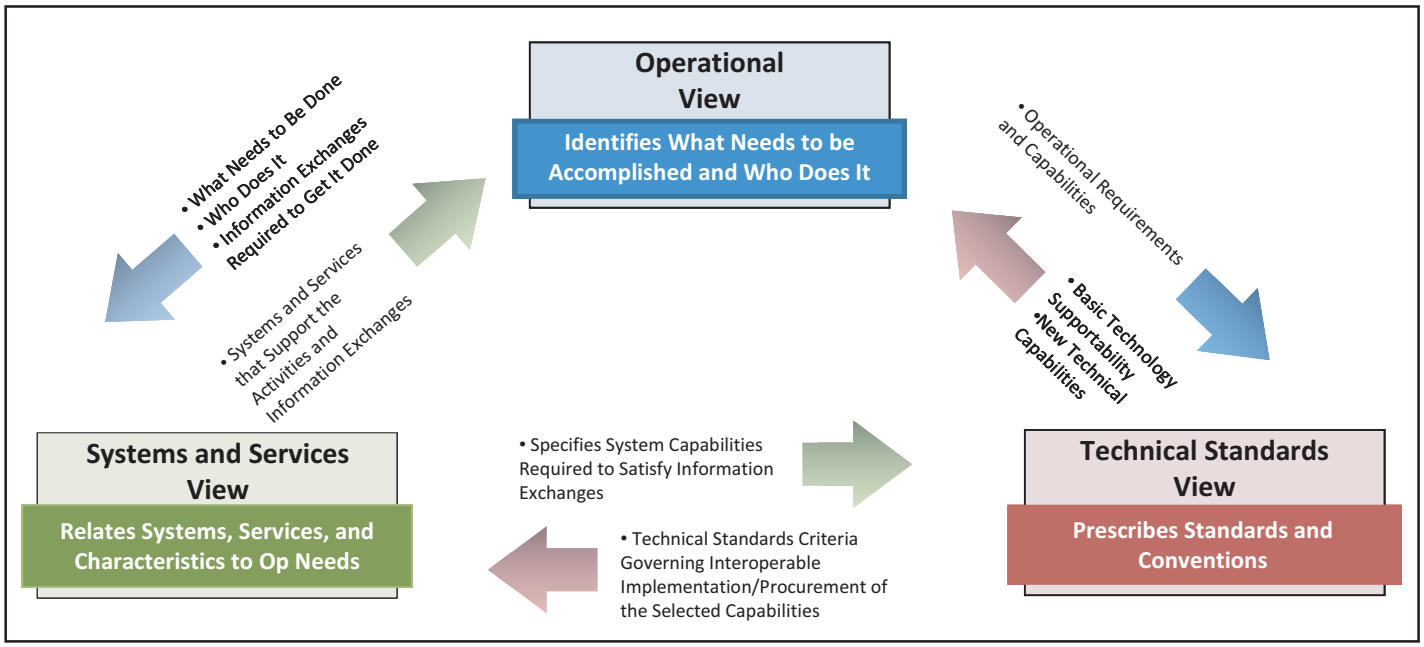

Figure 5. DoDAF Views and Linkages

constraints, always keeping in mind that the focus of using these tools is to unite the resources of the enterprise, and not to overcomplicate the effort.

Though an overarching view of EA has been presented, the concepts and various methodologies can still seem a bit nebulous. A few case studies where enterprise architectures have been implemented will now be examined. The hope is to clarify and give relevance to the discussion, and to highlight the realized advantages as well as some of the difficulties associated with architecture implementation. The following examples illustrate uses of EA within government agencies.

Case 1

The Food and Drug Administration (FDA) is the operating division of the Department of Health and Human Services (HHS), and is charged with ensuring foods, drugs, and cosmetics are safe and properly labeled; drugs and medical devices are safe and effective; blood is safe and in adequate supply, and equipment that uses radiant energy is safe.[14] In response to the President's 2002 Management Agenda, the HHS established its own initiative to consolidate, streamline, and standardize administrative programs. The FDA faced a few key challenges associated with the mandate: necessary alignment of information technology with business strategy, limited funding and resources, lack of standardized processes, and a culture resistant to change.[15]

The FDA began by adding a chief enterprise architect (CEA) position to its strategic IT management staff to oversee this undertaking. The CEA established an EA working group made up of representatives from each of the eight FDA center offices. Technical training was required to ensure personnel could adequately build and use EA frameworks, so representatives from the center offices received Federal Enterprise Architecture certification. The FEA reference models were chosen for architecture development in order to facilitate cross-agency analysis and the identification of duplicative investments, gaps, and opportunities for collaboration within and across the agency. The resulting products created a standardized architecture framework which served as a foundation to develop both baseline and future target EAs. Common governance structures were defined, ensuring each of the departments supported the FDA's goals and objectives. Additionally, an office of shared IT services was developed to provide better alignment between business and IT. This helped the agency to reuse and consolidate applications where possible. This office also enabled the FDA to track IT investments across the entire enterprise.

Though a significant investment was made to develop and maintain an enterprise architecture, benefits were soon realized. The budget for the maintenance of the EA is $350K to $500K annually, but the FDA projected a $10M savings over the first 5 years. This savings comes primarily from eliminating redundant IT costs. The infrastructure now helps to drive consolidation activities across the enterprise. With the transparency of the system, communication and efficiency were improved, leading to improved decisionmaking as well.[14]

The FDA provides a good example of enterprise architecture implementation. Today, the EA working group acts as a review board, selecting IT investments based on the FDA mission and objectives. As a continuing component of the IT strategy, the FDA's EA framework is reducing costs, and improving mission performance.

Case 2

The next case study involves US Customs and Border Protection (CBP). CBP is a component of the Department of Homeland Security and is primarily responsible for keeping terrorists and their weapons out of the US. The scope of this mission is threefold: covering border control, trade, and travel within the US. Presently, CBP employs 41,000 personnel who enforce hundreds of US regulations, including immigration and drug laws.[16]

Not all implementations of enterprise architecture are as clear-cut or initially successful as the FDA example. CBP encountered significant problems in earlier stages of its architecture development. Beginning in 1997, the US Customs Service planned to invest over $1B in a modernization effort to create an automated commercial environment (ACE) focused on certain core missions. In 1999, the Government Accountability Office (GAO) found that CBP was not managing this effort in a cost effective way. The GAO found serious weaknesses in architectural definition, investment management, and software development and acquisition. It was recommended that Congress withhold funding until these deficiencies were resolved.

CBP began preparing a new strategy starting with the development of the US Customs Modernization Program management organization. The organization is charged with establishing an EA systems concept for the ACE. The goals of the concept were to govern the modernization processes, align investments with strategic goals, and turn the CBP into a more performance based organization. A task force consisting of a planning group and a technology and architecture group (TAG) were created. The TAG was responsible for developing the enterprise architecture. The EA was a collaborative effort and involved stakeholders from each CBP business unit. A cost analysis, along with a metrics program to measure the benefits of implementing the EA was considered from the onset. The GAO worked in conjunction with CBP, validating their efforts throughout the process.

CBP's architecture ensures that IT investments are properly aligned with the architecture. Similar to the FDA, focus was placed on increasing IT standardization, minimizing duplication, providing better justification for IT spending, increased efficiency, and better responsiveness to customer needs. CBP produced the architecture using the four FEA reference models, and System Architect was used for modeling purposes. Further, the EA framework has evolved and, like the Air Force's AFEA, an enterprise-specific Treasury Enterprise Architecture Framework (TEAF) now defines all artifacts contained in the CBP EA.

CBP met with many of the same obstacles to architecture implementation as did the FDA. Initially, a major culture change was required within IT. Systems developers were not optimistic about compliance with new processes, standards, and controls. Development of an EA was also a major time commitment, taking 18 months to realize the initial functioning EA. There was also an upfront cost of $5M associated with the effort, and a continuing cost of $2M annually to update and maintain the EA.

Though CBP had a rocky start in developing EA, eventually the management weaknesses identified by the GAO were resolved and funding was restored. In addition to this, benefits are now realized. Evaluation processes have confirmed that over a $30M return on investment has been made, with over $5M of these savings resulting from the elimination of duplicative

systems. The IT infrastructure is much less complex now, and stovepiping of data, technology, and systems has been eliminated. Finally, change management is also facilitated, with the development of a *to be* architecture blueprint ushering in several new systems acquisitions.

Air Force Logistics Enterprise Architecture and the AFLMA

The AFLMA was recently given responsibility for the evaluation of LogEA. LogEA is intended to guide the transformation of the Air Force supply chain, and to stand as the single authoritative source of process and system models for this logistics chain. The current system must evolve into a rapid response, dynamically reconfigurable, integrated network, supporting the expeditionary aerospace forces (EAF) concept at home and in deployed locations.[17] Ultimately, the intent of LogEA is to deliver mission capability while maintaining affordability.

Several transformation initiatives have been implemented as part of the EA execution plan. This campaign, known as Expeditionary Logistics for the 21st Century (eLog-21), is intended to capture both the future vision and the transformation path for the Air Force logistics enterprise. LogEA is the operational and systems architecture that will communicate and guide the vision of the eLog-21 campaign.[16] The impact of these eLog-21 initiatives is measured against the high-level goals to improve operational capability while minimizing costs.

The elog-21 transformation initiatives are divided into 11 cost categories.

- Depot maintenance
- Depot level reparable
- Aviation fuels
- Consumables
- Sustaining engineering
- Contract service
- Military personnel
- Civilian personnel
- Software maintenance
- Other operations and maintenance
- Critical space operations

Each of the eLog-21 initiatives is classified as IT or non-IT, and architecture requirements are determined according to this classification. Artifacts are submitted to AFLMA for a review to verify LogEA compliance, according to the published LogEA Compliance Plan. The result of this process is an integrated set of enterprise-wide priorities which will reduce costs by improving the planning and execution of procurement and production activities.[16]

Challenges

It is clear that the lack of a system architecture can contribute to increased costs and subsystem problems, but even in successful architecture developments, common difficulties seem to arise. As the AFLMA manages LogEA, it is valuable to highlight some of these challenges.

Strategy

The cornerstone of a successful architecture begins with a strategic vision. This point is reflected in the AFEA Performance Reference Model. This model prescribes a roadmap for the entire architecture development as well as performance measures to calculate the success of the effort. This involves well-defined direction from the key sponsors and stakeholders that is directly traceable to the Air Force mission area under consideration. As illustrated in the case studies, the vision and scope for both efforts were clear, and architecting teams had focus and, most importantly, a shared concept of the effort. The CBP case study specifically illustrates the implementation of performance measures and metrics to calculate the benefit of implementing architecture. Cost/benefit analysis is a vital point in the decision to develop architecture. An organization must be willing to invest in the underlying organizational and cultural structures to support the EA, and be absolutely certain that these investments will pay dividends in the future.

Culture and Senior Commitment

Senior stakeholder commitment is also essential to initiating architecture development. Though policy direction ensures commitment from Air Force leadership regarding architecture development, other associated issues arise. It is crucial that organizations are creating artifacts with the strategic vision in mind and not simply to fulfill requirements and meet deadlines. The purpose of architecture can be summed up in one idea: optimizing limited resources. If focus shifts from this idea to simple fulfillment of requirements, the benefits of architecture will never manifest. To help guarantee effectiveness, the mandate to develop enterprise architecture should also provide for resources toward additional personnel, education, and training for those developing and evaluating architecture, and reasonable deadlines. Ideally, enterprise architecture development should focus first on understanding the existing process (as-is), and then the desired future state (to be). This practice lends support to the change management capability of EA. Products should be incremental and iterative, not a static set of artifacts to be archived and then forgotten.

Cost

With these ideas in mind, another issue comes to light; that is, architecture costs money. As shown in the case studies, both the FDA and CBP established a start-up budget as well as an annual maintenance budget for development and continuing management of the EAs. Many eLog-21 initiatives employed contractor support for architecture development. Attention should also be given to sustainment of the architecture products either internally, or with persistent contractor support. Ideally, contractor support can effectively be used to initiate enterprise architecture development when conducted in conjunction with permanent party personnel who can exercise continuing maintenance of the EA. Many architecture projects are overstaffed at the onset if critical architectural work needs to be expedited, which may indicate that an organization is not investing sufficient time in the architecture analysis and development.[18] DoDAF version 1.5 warns that the architectural views are not important; the key issue is the integrity of the data used to produce the views.

Communication

The nature of enterprise architecture is to capitalize on horizontal integration; standardizing processes and eliminating redundancies; which leads to another possible pitfall: communication. Some organizations charged with development of LogEA artifacts display a lack of communication across organizations, and cross flow of information among geographically separated organizations is an ever present issue. Without adequate communication between eLog-21 initiatives, systems that need to be integrated and interoperable may not achieve the overall goal. Some of the initiatives are so expansive that several large architecture teams are employed in disparate locations for artifact development. Significant differences in process understanding and even architecture styles are evident in many artifacts submitted for approval. If processes cannot be standardized within a single organization, it is easy to see how communicating vital information between agencies would be difficult. This problem of standardization is apparent throughout all levels of LogEA.

Standardization

Though all architecture products are measured by their adherence to the DoDAF by way of the LogEA Compliance Plan, there is no prescribed methodology or software package for architecture modeling. Though different product suites were used to develop enterprise architecture in each of the case studies, there was standardization of software and training for each project. Software integration and interoperability is a key element of enterprise architecture, so it would seem appropriate to ensure the same interoperability for all architecture developments. This is problematic as artifacts are approved and certified. Original products cannot be maintained in a central repository due to the lack of standardization among software, and it is a point of discussion how maintenance and archiving of the LogEA will be accomplished.

Conclusion

It has been said that the architecture of an enterprise exists, whether it is explicitly developed or not. By virtue of process, system, and technical make up, architecture is inherent in all organizations, even if it is not formally defined. The discipline of enterprise architecting allows the capitalization of the potential effectiveness and efficiency of an organization, while minimizing cost. A well established EA also guides acquisition of new technologies and facilitates change management and transformation. The institution of enterprise architecture has emerged as common practice within commercial industry, and is mandated now for all federal enterprises. Though enterprise architecture is not a topic requiring expertise for every member of an organization, it is valuable to have a fundamental understanding of what it is and why it is being used. This article was intended to provide the reader with a fundamental understanding of the background, practices, and possible complications associated with enterprise architecture. Though it is a relatively new mandate within the Air Force, EA will offer substantial benefits if properly implemented throughout the enterprise.

Notes

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Because of my wartime experience, I am insistent on the point that logistics know-how must be maintained, that logistics is second to nothing in importance in warfare, that logistics training must be widespread and thorough.…

—Vice Adm Robert B. Carney, USN