Chapter 2

Motivation and Impetus for Enterprise Architectures: Government, Federal, and Commercial Sectors

2.1. Introduction

Motivation and impetus for the Enterprise Architecture Frameworks (EAF) in the USA is to be found in three most significant sectors: Federal Agency Sector, Department of Defense (DoD), and the Private Sector, as depicted in Figure 1.

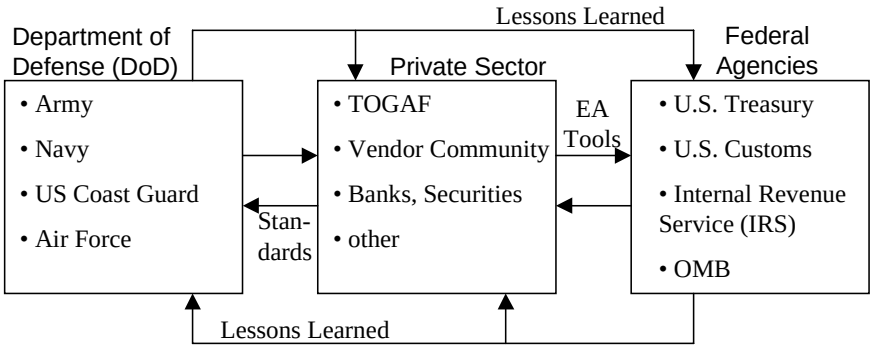

Figure 1. EA Synergism Among Federal Agencies, DoD, and Private Sector

Over the last 10-15 years organizations in the Federal Agencies and the Department of Defense have published guidelines and mandates for the design, construction, assessment, maintenance, and streamlining of

enterprise architectures. Organizations in the Private Sector (e.g., university and industry committees at national and international levels) on the other hand have gathered, studied, approved, and recommended technology-based guidelines and procedures (i.e., standards); small and large commercial organizations have also produced tools that aim to support enterprise architecture projects (e.g., Telelogic's System Architect, IBM's Erwin data modeling tool, Spark Systems's Enterprise Architect tool for UML representation, Rational Rose's software modeling and XML browser, other). It is in this triage of sectors that the synergism, promotion, and application of enterprise architectures (EA) is to be found today.

2.2. Organization of this Chapter

This chapter lists some of the benefits of building enterprise architectures (EA), it traces the beginnings of EA planning to the Clinger Cohen Act of 1996, the Office of Management and Budget (OMB) Circular A-130, and the Federal Enterprise Architecture Framework (FEAF) of 1999. "Work Products" are identified and described as the bodies of knowledge that make up the enterprise architecture frameworks (EAF), truly substantive, even monumental at times, volumes of text and graphics that document how an EA is supposed to be put together, how parts relate to each other across various architectural views, and how projects and subsystems will be fielded and deployed according to a multi-year schedule. Next, a very brief introduction of the DoD (C4ISR) and TOGAF frameworks and the Office of Management of the Budget (OMB) reference models, followed by a last section of exercises.

2.3. Benefits of an Enterprise Architecture

There are a variety of benefits to be derived from the planning, design, construction, operation, and maintenance of an enterprise architecture (EA):

- Achievement of economies of scale by providing services that can be shared across the entire enterprise (i.e., the organization).
- Improvement of consistency, accuracy, and timeliness of information technology (IT)-managed resources.
- Capture and dissemination of elements in the vision and mission of the organization for effective investment planning and decision-making.
- A basis of enterprise knowledge in areas of architecture requirements, business processes, vision and strategy for the future, data bases, the architecture of software applications, and an infrastructure of local area networks upon which rational decisions can be made regarding the implementation of the new technologies of information and communication (TICs); without the prior implementation of an enterprise architecture the implementation of the TICs will likely render very limited results; and
- Use of the EA by business planners and owners for purposes of strategic planning, coordination of operations across the organization, business process engineering, introduction of automation processes, reallocation of resources, modernization of legacy systems, assessment of new proposed technologies from the vendor community, and managing and priority setting of IT investments.

Enterprise
An organization supporting a defined business scope and mission. An enterprise is composed of intedependent resources (e.g., people, organizations, capital, and technologies). These resources must coordinate their functions and share information in support of a common mission.
Source: Adapted from TEAF

2.4. EA Development in the Federal Agencies

The direction and impetus for the planning, development, fielding, and operation of enterprise architectures derives from Federal legislation and

guidance in the USA, including the Clinger Cohen Act of 1996, the Office of Management and Budget (OMB) Circular A-130, and the Federal Enterprise Architecture Framework (FEAF) of 1999, as depicted in Figure 2.

More recently, the Office of Budget and Management (OMB) has proposed four "reference models": Business, Service Component, Technical Reference Model, and Performance Reference Model (OMB, 12 June 2003).

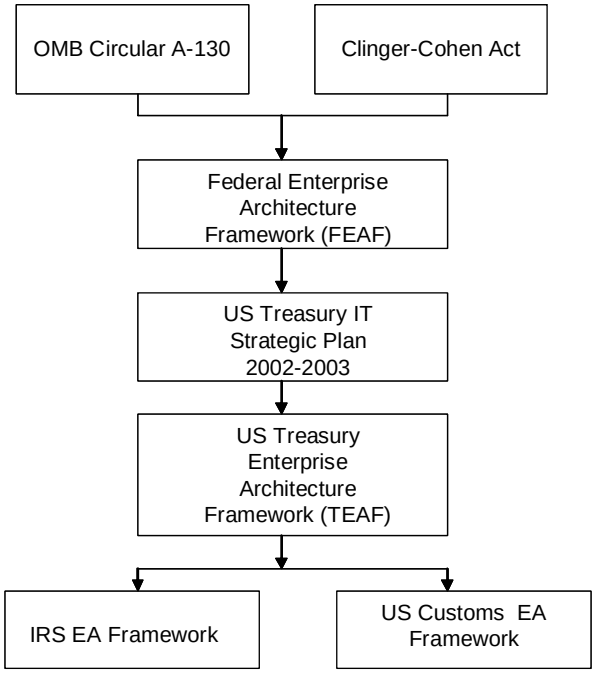

Figure 2. Enterprise Architecture Framework Development in the Federal Sector

2.5. Clinger-Cohen Act of 1996

Recognizing the importance of information technology for effective government, in 1996 Congress enacted the Information Technology Management Reform Act and the Federal Acquisition Reform Act,

which together these two acts are known as the Clinger-Cohen Act of 1996. This act directs Federal agencies to link IT investments (Information Technology, also known as Technologies of Information and Communication, TICs, in Europe) to agency accomplishments by:

- Requiring that agency heads establish a process to select, manage and control their IT investments.
- Providing for relief from cumbersome processes that add little value, but significant cost to the acquisition of information technologies.
- Allowing DoD to focus on the appropriate use and management of information technology resources.
- Reducing the amount of time an information technology acquisition takes by reducing the number and frequency of protests "while moving the Department in the direction of the use of sound acquisition strategies".
- Providing a framework for performance measurement and capital planning titled "Performance-Based Management: Eight Steps to Develop and Use Information Technology Performance Measures Effectively", which is based on lessons learned from Federal and State governments as well as private industry.

Enterprise Architecture (EA)
A strategic information asset base which defines the agency's mission and business activities supporting the mission, the information necessary for agency operations, the technologies needed to support the operations, organizational needs, and transitional strategies to implement business and technology changes. An enterprise architecture is an integrated model or representation.
Source: Adapted from FEAF version 1.1

The term "agency" here means any executive department, military department, government research center, or other establishment in the

executive branch of the Federal government, as well as regulatory agencies. Within the Executive Office of the President, the term includes only OMB and the Office of Administration.

2.6. OMB Circular A-130

This circular directs Federal Agencies to conduct their information management planning in specific ways. Agencies will:

> **Framework**
> A logical structure for classifying and organizing complex information, including a set of guidelines for the construcion of an Enterprise Arcuitecture (EA)
> *Source*: FEAF version 1.1

(a) Consider, at each stage of the information life cycle, the effects of decisions and actions on other stages of the life cycle, particularly those concerning information dissemination;
(b) Consider the effects of their actions on members of the public and ensure consultation with the public as appropriate;
(c) Consider the effects of their actions on State and local governments and ensure consultation with those governments as appropriate;
(d) Seek to satisfy new information needs through interagency or intergovernmental sharing of information, or through commercial sources, where appropriate, before creating or collecting new information;
(e) Integrate planning for information systems with plans for resource allocation and use, including budgeting, acquisition, and use of information technology;
(f) Train personnel in skills appropriate to management of information;
(g) Protect government information commensurate with the risk and magnitude of harm that could result from the loss,

misuse, or unauthorized access to or modification of such information;

(h) Use voluntary standards and Federal Information Processing Standards where appropriate or required;

(i) Consider the effects of their actions on the privacy rights of individuals, and ensure that appropriate legal and technical safeguards are implemented.

With reference to the definition and purpose of enterprise architectures, the Circular is also specific:

> An EA is the explicit description and documentation of the current and desired relationships among business and management processes and information technology. It describes the "current architecture" ("As-is") and "target architecture" ("To-be") to include the rules and standards and systems life cycle information to optimize and maintain the environment which the agency wishes to create and maintain by managing its IT portfolio. The EA must also provide a strategy that will enable the agency to support its current state and also act as the roadmap for transition to its target environment. These transition processes will include an agency's capital planning and investment control processes, agency EA planning processes, and agency systems life cycle methodologies… Agencies must implement the EA consistent with following principles:
>
> (i) Develop information systems that facilitate interoperability, application portability, and scalability of electronic applications across networks of heterogeneous hardware, software, and telecommunications platforms;
>
> (ii) Meet information technology needs through cost effective intra-agency and interagency sharing, before acquiring new information technology resources; and
>
> (iii) Establish a level of security for all information systems that is commensurate to the risk and magnitude of the harm resulting from the loss, misuse, unauthorized access to, or

modification of the information stored or flowing through these systems.

With regards to the creation and maintenance of the EA, the Circular states (verbatim, next six paragraphs):

(1) As part of the EA effort, agencies must use or create an Enterprise Architecture Framework. The Framework must document linkages between mission needs, information content, and information technology capabilities. The Framework must also guide both strategic and operational IRM planning.
(2) Business Processes - Agencies must identify the work performed to support its mission, vision and performance goals. Agencies must also document change agents, such as legislation or new technologies that will drive changes in the EA.
(3) Information Flow and Relationships - Agencies must analyze the information utilized by the agency in its business processes, identifying the information used and the movement of the information. These information flows indicate where the information is needed and how the information is shared to support mission functions.
(4) Applications - Agencies must identify, define, and organize the activities that capture, manipulate, and manage the business information to support business processes. The EA also describes the logical dependencies and relationships among business activities.
(5) Data Descriptions and Relationships - Agencies must identify how data is created, maintained, accessed, and used. At a high level, agencies must define the data and describe the relationships among data elements used in the agency's information systems; and
(6) Technology Infrastructure - Agencies must describe and identify the functional characteristics, capabilities, and interconnections of the hardware, software, and telecommunications.

2.7. Federal Enterprise Architecture Framework (FEAF) of 1999

Established by the Chief Information Officers (CIO) Council 1n 1999, The Federal Enterprise Architecture Framework (FEAF) promotes shared development for common Federal processes, interoperability, and sharing of information among the Federal agencies and other Governmental entities, in response to the Clinger-Cohen Act of 1996. To that end, the Framework consists of various approaches, models, and definitions for communicating the overall organization and relationships of architecture components required for developing and maintaining a Federal Enterprise Architecture. There are four levels of increasing detail. The fourth level provides detail of a framework that is based on a tailored version of the Zachman framework (Zachman, 1987). This master framework then serves as an "umbrella" set of guidelines for the development of EA frameworks by and within the various individual agencies, as discussed next.

2.8. US Treasury Enterprise Architecture Framework (TEAF)

Among the various Departments in the US Government, the Department of the Treasury is one of several leading organizations in the promotion of a Treasury enterprise architecture framework (TEAF) in response to the FEAF and the Treasury IT Strategic 2000-2003 Plan. Goals of the TEAF include:

- To guide the Treasury Bureaus and offices in meeting and satisfying federal requirements, including those stated in the Clinger-Cohen Act and OMB Circular A-130.
- To provide guidance in the development, maintenance, and general use of EAs as an integral part of normal business planning and management activities.
- To highlight the value-added benefits of establishing and maintaining an Enterprise Architecture (EA), and
- To encourage Bureaus and Offices to evolve and share best practices across business and engineering activities in the enterprise.

2.9. Enterprise Architecture Framework (EAF)

A framework is a logical structure for classifying and organizing complex information (FEAF version 1.1). An enterprise architecture framework is then a logical structure for classifying and organizing information on the software, hardware, and procedural composition of an enterprise architecture, including information on how the various architectural components relate to each other (i.e., metadata) in response to the desire to meet a set of system requirements. To manage complexity, the information needed to develop the EA is gathered into several compartments so as to be able to use it independently or subsequently in separate projects. Specifically, the TEAF is organized into four views (Functional View, Information view, Organizational View, and Infrastructure View), four perspectives (EA Planner, Owner, Designer, and Builder), and multiple work products, as depicted in Figure 3. Additionally, the TEAF provides direction and guidance in the construction of an EA by organizing the work products into three groups: EA Direction group, EA Description group, and EA Accomplishment group, to be prepared in that order.

2.10. Technical Architecture Framework for Information Management (TAFIM)

Moving now to our description of EA work in the Department of Defense (DoD), by 1990 it had already become apparent to many armed services that military systems and architectures were becoming increasingly complex and that the need existed to help guide the design, implementation, operation, management, and evolution of these systems. Accordingly, in 1994 DoD created the Technical Architecture Framework for Information Management (TAFIM) in order to provide guidance for the evolution of DoD technical that meet specific mission requirements while providing for multiple desired system characteristics such as interoperability, portability, and scalability.

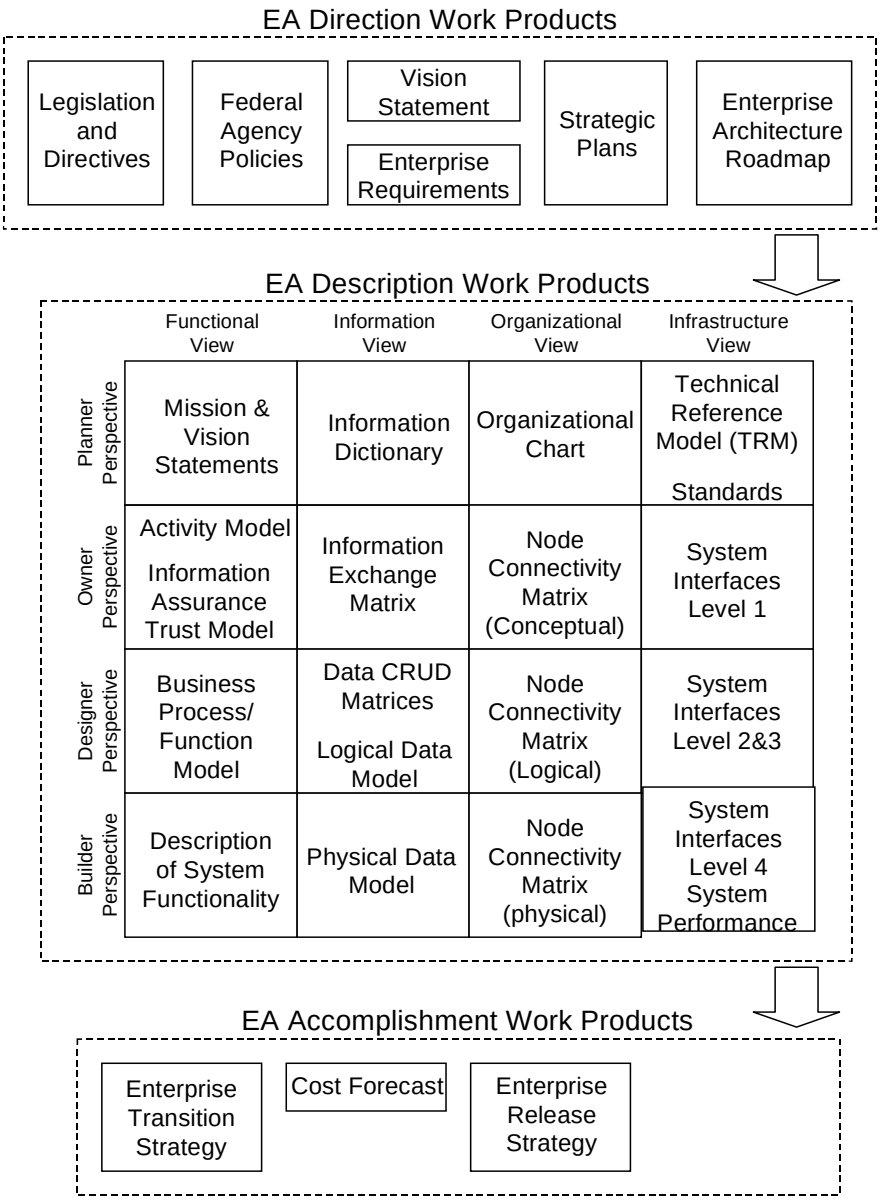

Figure 3. Resource and Work Products for EA Direction, Description, and Accomplishment (*Source*: Adapted from TEAF vs. 1.1)

Accordingly, the TAFIM consisted of multiple bodies of information and guidance:

- A *Technical Reference Model (TRM)* to provide a conceptual model for information system services and their interfaces in the architecture. See Chapter 4 for a detailed description of the TRM.
- *Architecture Concepts and Guidance Design* with concepts and guidance for the design and integration of architectural components.
- A *DoD Standards-Based Architecture Planning Guide* for the translation of functional requirements into business services, standards, components, configuration of these components, their phasing, and the acquisition of products and services to implement them.
- A *DoD Goal Security Architecture (DGSA)* that addressed security requirements derived from mission statements and threat descriptions.
- An *Adopted Information Technology Standards (AITS)* intended to guide DoD acquisition and the migration of legacy systems while supporting multiple TAFIM objectives such as interoperability, reduced life-cycle costs, and security.
- A *DoD Human Computer Interface (HCI) Style Guide* which provided a common framework and set of concepts in HCI design and implementation.

The TAFIM did serve well the armed services community from 1998 until 7 January 2000 when it was cancelled by Architecture Coordinating Council (ACC) in response to a shifting in the strategic direction of all architectural efforts in DoD caused by challenges in its implementation (Perks and Beveridge, 2003), including:

- Time in years required to build a TAFIM architecture can be so great, 3-5 years, that the architecture would be obsolete from the very beginning;
- Considerable IT and business modeling expertise required, thus often times the final product was difficult for business oriented professionals to follow and understand;

– No specific method was offered to the general public to build TAFIM-like architectures.

The TRM portion of TAFIM, however, was deemed relevant to existing needs in DoD and allowed to continue as a guiding document. See Chapter 4, The Business Systems Architectural View for a description of the Technical Reference Model (TRM).

2.11. Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) Architecture Framework

In October 1995 the Deputy Secretary of Defense directed that a DoD-wide effort be conducted "to define and develop better means and processes for ensuring that C4I capabilities meet the needs of war fighters", such as military aircraft, ships, and tank units. Towards that end, an integration task force (ITF) was formed under the direction of the Assistant Secretary of Defense for C4ISR consisting of representatives from the Joint Chiefs of Staff, the military Services, and DoD agencies. This ITF eventually emerged with a set of recommendations for the definition of an architectural framework that features three related architecture types or views:

- Operational View
- Systems View, and
- Technical View

Finally, on February 23, 1998 the tri-chairs of the Architecture Coordination Council (ACC) established the C4ISR architecture framework as a critical element of that change in strategic direction for all architectural efforts in DoD. Accordingly, the C4ISR framework provides rules, guidance, and work product descriptions to guide the development of interoperable, scalable, and cost-effective military systems across Joint and combined organizational boundaries. It is worth noting that while this framework provides direction on how to describe architectures, it does not provide guidance in how to design or implement architectures, or how to develop and acquire systems.

By June 1996 the C4ISR framework had steadily gained acceptance and support within many of DoD Services, and on 23 February 1998 the Office of the Secretary of Defense mandated the C4ISR as the EA framework to use across all Services. See Chapter 13 for a presentation of salient features of the C4ISR framework.

2.12. The Open Group's Architectural Framework (TOGAF)

Individuals and organizations in the Private Sector have also played a significant role in the creation and promotion of EA frameworks and their application to enterprise needs. The Open Group's Architectural Framework (TOGAF), for example, an open-source framework that embodies significant intellectual property and experience in architectural development.

> *A technical Architecture: A capability, a discipline, and an approach used to define, apply, and maintain the technology environment within the organization. It embodies the life cycle for defining the organization's technical strategy, setting and adopting technical standards, and maintaining the technology environment through changes in both business and technology. It can be thought of as the technical equivalent of the business strategy (i.e., the future shape of business given a current environment) (Perks and Beveridge, 2003).*

See Chapter 12 for a description of salient features of TOGAF, including the Standards Information Base (SIB), TOGAF's Technical Reference Model (TRF), and the Architectural Development Method (ADM).

2.13. OMB Reference Models

The Federal Enterprise Architecture (FEA) story is still in the making, and most likely will continue for the balance of this decade. On 12 June 2003 the Office of Management and the Budget (OMB) rolled out the latest FEA version, including a draft of a Business Reference Model

(BRM), a Service Component Model (SRM), and a Technical Reference Model (TRM). As of this date, OMB is working closely with federal agencies to extend these three models and add still two more models: a Performance Reference Model (PRM), and a Data and Information Reference Model (DRM), as shown on Figure 4.

The feeling among some EA-users in the Federal agencies reflects a frustration with lack of common measures of business and operational performance. "These models will enable better alignment of IT and the business of government. OMB and agency officials will use them to improve agency performance, increase intergovernmental collaboration and reduce costs for the taxpayer, furthering the goals of the President's Management Agenda and making government services more citizen centered", according to Mark Forman, OMB's Administrator for E-Gov and IT (Executive Office 2003). It is a bit early to tell yet, but likely the OMB Reference Models will significantly impact the direction, applicability, and assessment of EA frameworks in the Federal Agencies. See Hagan (2003) or a detailed presentation of the structural content of these models and their intended use in the Federal Agencies.

2.14. Conclusion

Enterprise Architecture (EA) frameworks are seen today by many decision makers in the Federal agencies, the Department of Defense (DoD), and some corporations in the private sector as the answer to very real needs in IT investment and enterprise resource management. Salient features of major EA frameworks were presented in this chapter, including FEAF, TEAF, TAFIM, TOGAF, and C4ISR/DoD, as well as a glimpse at OMB's forthcoming reference models. The writing is in the wall: EA frameworks are here to stay, for the foreseeable future, anyway, and these represent the vehicles that government, and to a significant extent individuals and organizations in the business and industrial communities, will use to address those IT investment and management challenges.

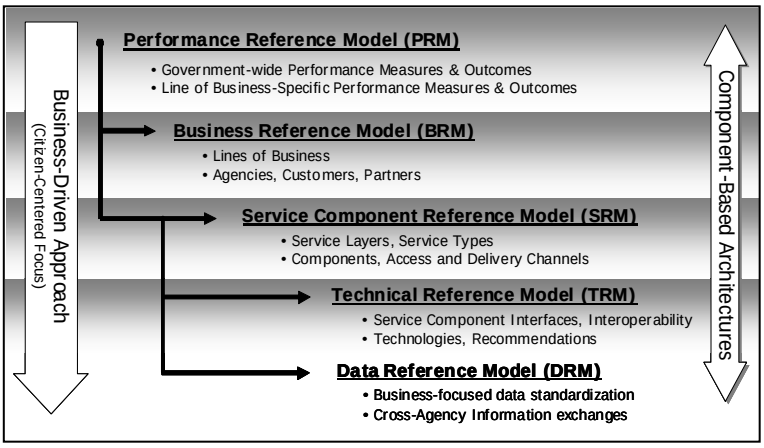

Figure 4. OMB Reference Models (*Source*: FEA-PMO Using the Business and Performance Reference Models to Help Improve Citizen Services, by Norman Lorentz, Oct 7-8, 2002)

2.15. Exercises

E2.1 Select a Federal Agency, conduct a search of the Web/Internet, and provide a narrative of each of the following components of its Enterprise Architecture (EA) framework:

(a) Vision/Mission Statement
(b) Organizational chart
(c) Business Processes; types of services this Agency provides
(d) High-level view of its technical architecture (if available)
(e) Technical reference model

Also, discuss briefly how the "architecture-to-be" for this agency is intended to be different, better, or more efficient than the "architecture-as-is", i.e., the present EA.

E2.2 How are the OMB Reference Models intended to complement the existing mandate and functionality of the FEAF? Conduct a search of the Web and prepare a 1-2 page critique.

E2.3 Who are the promoters of TOGAF today? Research this topic and prepare a briefing that address the following:

(f) Constituency of the Open Group, i.e., general description of individuals, university organizations, URL, business and industry organizations
(g) Cite one application of TOGAF in the private sector, e.g., title of paper or report, name of journal or organization, and half page discussion of this application
(h) An update of TOGAF today, sponsors, demand for its use in the private sector

E2.4 Identify and list three forthcoming USA Conferences or Workshops that feature EA papers, and include a listing of paper topics with applications in the Federal Agencies, DoD, and corporations, if available.

E2.5 Identify and list three forthcoming International Conferences or Workshops that feature EA papers, and include a listing of paper topics with applications in the Federal Agencies, DoD, and corporations, if available.

E2.6 Identify a list of colleges and universities in the USA that offer courses or workshops in EA planning, design, and/or assessment. List course titles and description, if available.

E2.7 Homeland Security Enterprise Architgecture. Search the Web and prepare a 1-2 page briefing on why this architecture got started, how its design and implementation is progressing, views for and against this public investment.