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EFFECTIVELY MANAGING THE

AIR FORCE ENTERPRISE ARCHITECTURE

THESIS

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AFIT/GIR/ENV/05M-16

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AIR UNIVERSITY

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Wright-Patterson Air Force Base, Ohio

AFIT/GIR/ENV/05M-16

EFFECTIVELY MANAGING THE

AIR FORCE ENTERPRISE ARCHITECTURE

THESIS

Presented to the Faculty

Department of Systems and Engineering Management

Graduate School of Engineering and Management

Air Force Institute of Technology

Air University

Air Education and Training Command

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Information Resource Management

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EFFECTIVELY MANAGING THE

AIR FORCE ENTERPRISE ARCHITECTURE

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Abstract

The Air Force is developing and implementing an enterprise architecture to meet the Clinger-Cohen Act's requirement that all federal agencies use an architecture to guide their IT investments. However, this act does not provide guidance on how to effectively manage an enterprise architecture. Prior research applied maturity models and competency stages to manage an enterprise architecture by defining layers of enterprise architecture management maturity. However, these efforts tend to view enterprise architecture development as a one-time planning process rather than an iterative progression.

Enterprise architecture is not a one-time exercise, but rather it is an on-going effort within the organization to rationalize, integrate, and optimize the IT capability within an organization across many projects and business units. Hence, the critical success factors to effectively manage an enterprise architecture must be identified to ensure the structure, processes, and governing mechanisms are established within the organization for maintaining an enterprise architecture.

This research draws from existing academic, professional, and government literature to identify the key issues affecting the Air Force's ability to manage its enterprise architecture effectively. Once identified, a quantitative analysis will assist in interpreting the qualitative findings in hopes of determining the underlying factors driving these issues.

Acknowledgements

In producing this "book report", my personal goal was to truly understand and to be able to apply the research investigative process. I am more than grateful to my advisor Dr. Kevin Elder for always being willing to provide assistance no matter what the location it may be. His steadfast and uncomprising character helped me focus on those things I could control and to set aside those that I only wish I could. I would also like to thank my readers, Dr. Michael Grimaila and Captain David Bouvin for their time and words of encouragement. Finally, I not only want to thank my wife and kids for their understanding and patience during the endless days and nights I spent working on my "book report", but I give all the glory and honor to my Lord and Savior. For it was only through Him that I was able to accomplish this task.

Jamie P. Sharkey

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EFFECTIVELY MANAGING THE

AIR FORCE ENTERPRISE ARCHITECTURE

I. Introduction

Overview

In 1884, construction began on the Winchester Mystery House in San Jose,

California. When construction was completed, the house consisted of 160 rooms and

24,000 square feet of living space. There was no blueprint for this construction project;

therefore, it took the 147 builders 38 years to erect this house at a cost of $5.5 million

(equivalent to $165 million today). Without a master plan, there was no orchestration of

the innovative skill and talent used to construct this house. In the end, 13 stairways led to

nowhere, 65 doorways opened to blank walls, 24 skylights were embedded in the floors,

and one chimney rose the entire height of the house only to stop short of the roof by two

feet (Wennergren, 2004).

To effectively design and construct a building, a blueprint must be developed and

maintained. A blueprint consists of a set of drawings that defines the various

characteristics of the building. Each drawing is complementary of the others and

provides a different view of the construction project. Therefore, the blueprint results in a

framework, which allows architects, engineers, and construction personnel with divergent

skill sets to "speak" a common language. This framework allows communication to

become more efficient and creates an effective roadmap for transforming raw materials into a finished structure.

The Air Force is employing a blueprint known as the Enterprise Architecture Framework (AF Chief Architect's Office, 2003). This framework permits the business, combat support, and combat operations organizations to "speak" a common language. More importantly, it is advancing the integration of its operational and technological environments. The framework's descriptive models allow decision makers to understand the complexities around how the two environments operate today and how they should operate in the future. Just like a construction blueprint, an enterprise architecture framework can provide a common language and roadmap that clarifies the interrelationships among enterprise operations and the underlying Information Technology (IT) infrastructure.

Motivation for Research

Developing and implementing an enterprise architecture has been identified as one of the top four Information Systems (IS) management issues since 1987 (Brancheau and Wetherbe, 1987; Niederman, Brancheau et al., 1991; Brancheau, Janz et al., 1996). These studies recognized there was no overarching framework guiding investments in information technology. As the private sector focused on exploiting their enterprise architecture to integrate its IT investments with its business objectives, similar studies conducted on public agencies have proved to have different outcomes. Swain and White identified developing an enterprise architecture as thirty-third in importance among top issues of public IS managers (Swain, White et al., 1995).

One year later, Section 5125 of the Clinger-Cohen Act, as implemented by Congress, required all federal agencies' Chief Information Officers to develop, implement, and maintain an enterprise architecture. To strengthen the enforcement of this act the Office of Management and Budget (OMB), under the guidance of the Government Accounting Office, issued Circular A-130 requiring all federal agencies' investments in information systems to be based on their enterprise architecture.

Due to these mandates, the Air Force has developed an enterprise architecture to guide its investment in information systems. Furthermore, it provides decision makers with the ability to synchronize mission requirements, programming, budgeting, and acquisition management with information systems planning. To implement and manage the Air Force enterprise architecture the Air Force Communications Agency (AFCA) transitioned from SCOPE Network teams that focused on optimizing and securing the base networks to SCOPE EDGE teams. While SCOPE Net's mission was network optimization SCOPE EDGE has increased the level of responsibility to include strategic network advocacy and enterprise level impact assessment (Hoeft, 2004).

In response to this change in mission, this research effort supports AFCA by identifying the key issues affecting the Air Force's ability to manage its enterprise architecture effectively. Once identified, a quantitative analysis will assist in interpreting the qualitative findings in hopes of determining the underlying factors that drive these issues. Therefore, the purpose of this research is to identify and analyze the key issues affecting the Air Force's ability to manage its enterprise architecture.

Research Question

To address the purpose of this research, the following central organizing research question is posited: What does literature identify as the key issues affecting the Air Force's ability to effectively manage its enterprise architecture?

Investigative Questions

This research effort will address multiple investigative questions in order to answer the main research question:

1. What is an enterprise architecture?

2. How does the Air Force define its enterprise architecture?

3. What does the literature identify as the issues that must be addressed to effectively manage an enterprise architecture?

4. Which issues have the most relevance?

5. What does the literature identify as the underlying factors driving these issues?

Methodology

A sequential exploratory research method was conducted. Therefore, this research effort was completed in two phases. The initial phase consists of collecting relevant white papers, case studies, and prior empirical and exploratory research efforts. These documents cover the enterprise architecture and information system (IS) strategic planning fields of study. A content analysis identified, categorized and synthesized the literature to discover the main attributes and to extract themes from the articles regarding the management of the enterprise architecture. The second phase quantitatively analyzed the identified issues the Air Force must assess to determine its effectiveness in managing

its enterprise architecture. Not only did this analysis determine the most relevant issues, but it also determined the underlying factors driving these issues.

Significance

Prior research efforts have focused on identifying the key issues involved in developing and implementing an enterprise architecture by investigating case studies involving the implementation of enterprise architectures and the utilization of IS strategic planning (Brancheau and Wetherbe, 1986; Earl 1993; Kim and Everest, 1994; Periasamy and Feeny, 1997; Shanks, 1997; Segars and Grover, 1998; Ross, 2003). However, these studies have not methodically identified and analyzed the key issues in successfully managing an enterprise architecture and the factors driving these issues.

This research effort synthesizes the literary efforts of a wide range of academic and professional authors. This synthesis provides AFCA with a strategic guidepost to broaden their understanding of the holistic perspective required to manage the Air Force's enterprise architecture. It also fulfills the identified academic void by methodically identifying the key issues surrounding managing an enterprise architecture.

Thesis Overview

Chapter I supplies an overview of enterprise architecture, the motivations for research, the research question, investigative questions, a description of the study, and the significance of completing this research effort. The remainder of this thesis reports the efforts to address the research questions presented in this chapter. Chapter 2 defines what is an enterprise architecture, followed by the Air Force's description and definition of its enterprise architecture. In addition, a literature review of enterprise architecture research

is presented to provide the theoretical foundations of this research effort. Chapter 3

expounds upon the justification for the methodology used along with a systematic guide

explaining how the content analysis was performed. Chapter 4 sets forth a detailed

analysis of the collected data and the findings that resulted from the employed

methodology. Finally, Chapter 5 provides conclusions, limitations, and

recommendations for future research.

II. Literature Review

Overview

This review examines the literature relevant to the research topic of enterprise architecture. From this examination a common frame of reference for this exploratory research is presented. First, an enterprise architecture is defined. Then a description of the Air Force's enterprise architecture is covered leading to an operational definition. Finally, the existing research in the field of enterprise architecture will be reviewed to provide the theoretical foundations of this research.

Defining an Enterprise Architecture

The term Enterprise Architecture (EA) lacks a universally accepted definition. Prior to discussing the theoretical foundation of this research, a common frame of reference is established by presenting an operational definition of an enterprise architecture. Until 1986, there was little consistency among the concepts and terminology regarding enterprise architectures. In response, John Zachman presented a conceptual framework for defining this term.

This framework, a two-way matrix as presented in Figure 1, consists of six views and six information sources. The six views represent the perspective of each participant included in the enterprise architecture development process. Each view is independent of the next. Therefore, the level of detail does not increase with each successive layer. Instead, it varies within each participant's architectural representation (Zachman, 1987).

To allow each participant's enterprise architecture representation to vary six information sources are presented across the top of the matrix. Collectively, these sources comprise each level's description. Just as the perspectives stand alone, so do the six descriptions. This allows the participants to describe the same product in multiple ways, which provides them with the ability achieve multiple purposes with an enterprise architecture (Zachman, 1987).
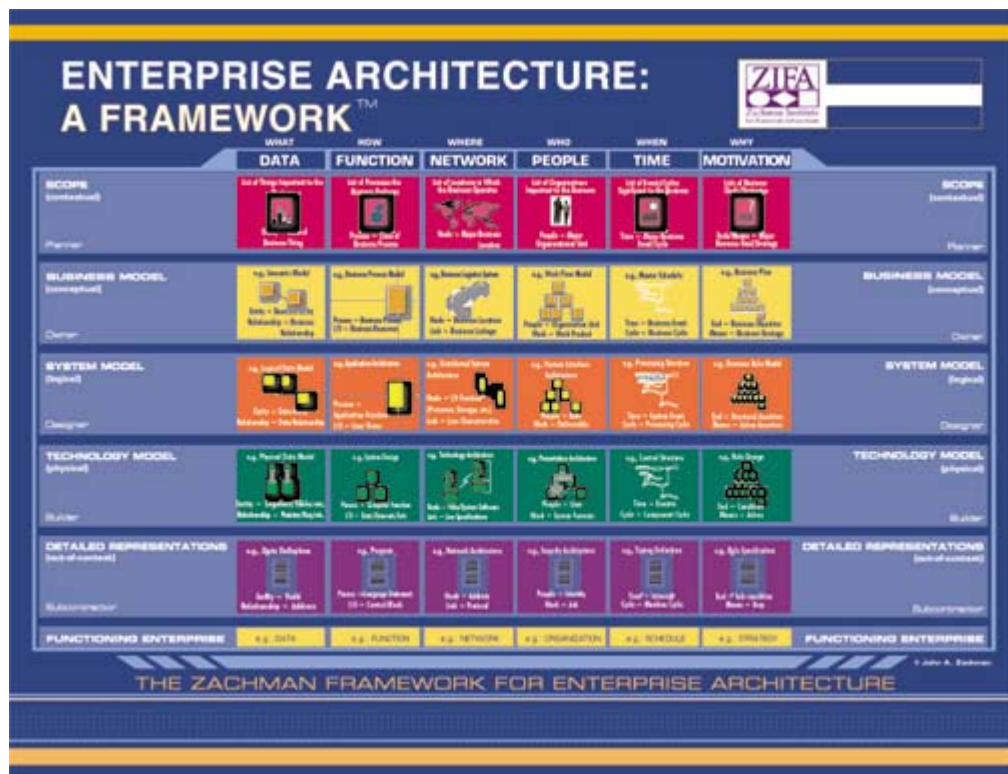
Figure 1. Zachman's Framework

Since Zachman's seminal research, several studies have made attempts to further clarify the concepts surrounding enterprise architecture. Kim and Everest expanded on Zachman's definition of an enterprise architecture by presenting four sub-architectures: process, data, control, and technology (Kim and Everest, 1994). These four sub-architectures link IS planning with the corresponding levels of Zachman's architecture. Similar to Zachman's framework, the views complement each other and taken

collectively present an IS enterprise architecture that provides the basis for constructing an information system and managing information resources (Kim and Everest, 1994).

Segars and Grover's describe the development of an IS architecture as a three-level hierarchy of analysis and development and can be summarized as follows (Segars and Grover, 1998):

- Conceptual modeling—a level at which broad business, information, process and data categories and interrelationships are identified

- Logical systems level—core concepts are expanded, structural relationships between architecture components are mapped, and sufficient detail is captured to enable the identification of applications, databases and core business processes

- Physical level—logical constructs are realized in operational system and databases, within the constraints imposed by specific performance and topological physical system requirements

This description concludes that the development of an IS architecture is a set of high-level models showing corporate data, process and application structures in logical form, supported by a set of corporate definitions of core data and process components (Hamilton, 1999).

Even though research was completed to refine the definition of an enterprise architecture terminology such as architecture and infrastructure were still being used interchangeably. This stemmed from referring to the enterprise architecture as a "city plan" which focuses on developing detailed drawings of the interconnections between processes, infrastructure, data, and applications (Ross, 2003). Using the enterprise architecture in this fashion does not capture its ability to tie itself to the organization's

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business strategy. Therefore, Ross provided the following definition of an enterprise architecture (Ross, 2003):

An enterprise architecture is the organizing logic for applications, data, and infrastructure technologies, as captured in a set of policies and technical choices, intended to enable the firm's business strategy.

By looking across each of these conceptualizations of an enterprise architecture a common theme presents itself. Therefore, the operational definition of an enterprise architecture for the purpose of this research is the organization of computing resources in an organization, which consists of data, information, applications, infrastructure, and personnel to enable a firm's business strategy.

Defining the Air Force's Enterprise Architecture

As academic literature refined the definition of an enterprise architecture, the federal government passed public laws and issued directives requiring each agency to use an enterprise architecture. For example, OMB Circular A-130 requires each agency to use an EA to document the linkages between its mission needs, information content, and information technology capabilities. In fulfilling this requirement the Department of Defense (DoD) leveraged Zachman's framework to develop the DoD Architecture Framework (DoDAF).

The DoDAF, Version 1.0, defines a common approach for DoD enterprise architecture description development, presentation, and integration for both warfighting operations and business operations and processes (DoD Architecture Framework Working Group, 2004). By providing a common foundation this framework ensures

architecture descriptions can be compared and related across both Joint Service and multinational boundaries. To achieve this objective Zachman's Enterprise Architecture Framework was condensed to an Operational View, a Systems View, and a Technical Standards View. The condensed version of Zachman's Enterprise Architecture Framework, known as the DoD Architecture Framework is presented in Figure 2. As can be seen, the DoD reduced the number of descriptions for each layer of the architecture from six to three.

Perspective	Product		
Planner	Operational View	System View	Technical View
Owner			
Designer			
Builder			
Subcontractor			

Figure 2. DoD Architecture Framework

Just as in Zachman's Framework, each perspective is independent of the next. Therefore, the level of detail does not increase by traveling down through the successive layers of the matrix. However, the three views provide a means to model their respective architecture components according to the requirements for each perspective. Through this decomposition, several diagrams of the same perspective are developed allowing the participant's perspective to be described in multiple ways. Table 1 presents a summary of the three views contained within the DoD's Architecture Framework (DoD Architecture Framework Working Group, 2004).

Table 1. DoD Architecture Framework Views

View	Definition
Operational	A description of the tasks and activities, operational elements, and information exchanges required to accomplish DoD warfighting missions and business processes. This view identifies operational nodes and elements, their assigned tasks and activities, and information flows required between nodes.
System	A set of graphical and textual products describing systems and interconnections that support DoD warfighting and business functions. This view associates system resources to the Operational View by determining which system resources support the operational activities and facilitate the exchange of information among operational nodes.
Technical	A minimal set of rules governing the arrangement, interaction, and interdependence of system parts or elements to ensure a system satisfies a specified set of operational requirements. The TV provides the technical systems implementation guidelines upon which engineering specifications are based, common building blocks are established, and product lines are developed.

The AF Enterprise Architecture Framework (AF-EAF) tailored and refined the standards set by the Department of Defense Architecture Framework for use by the Air Force. The AF-EAF is a taxonomy of pertinent information used to systematically describe and document the Air Force Enterprise Architecture (AF-EA). This taxonomy is a key construct in the advancement of the Air Force's integration efforts, allowing for the interoperability among the Air Force's and the Joint Services' information systems. Additionally, the architecture acts as a tool allowing the Air Force's vision, mission, and operational concept planning to be fully synchronized with programming, budgeting, and acquisition management (Roche, 2002).

The AF-EAF does not define the Air Force's Enterprise Architecture. Instead, the framework is a tool that is used to present the various models, perspectives, and definitions for communicating the architecture's components. As shown in Figure 3, the AF-AEF consists of three parts. Each part is used as a communication tool to establish a common foundation for integrating architectures (AF Chief Architect's Office, 2003).

AF Enterprise Architecture Descriptions

Architecture Drivers & Inputs	Enterprise Perspective Descriptions	Architecture Uses & Impacts
	Mission Area & Cross Mission Area Perspective Descriptions	
	Program & Node Perspective Descriptions	
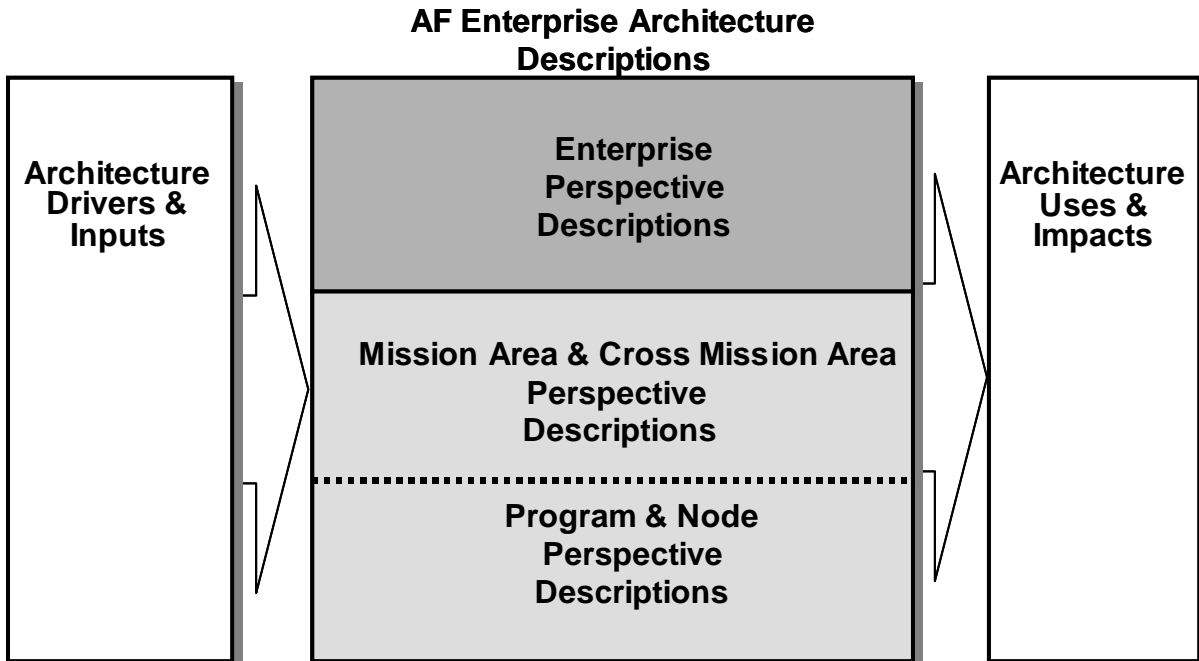
Figure 3: Air Force Enterprise Architecture Framework

Architecture Drivers and Inputs

One of the main drivers of the AF-EA is the Chief of Staff of the Air Force's six Concepts of Operation (CONOPs). These CONOPs provide the strategic direction for the development of the AF-EA. In turn, the enterprise architecture is leveraged as a foundation allowing for the integration of business and combat support elements with each other along with combat operations (Roche, 2002). The establishment of this relationship was directly influenced by an assortment of public laws, policies, directives, and architecture governance direction. Table 2, located below, provides a synopsis of the drivers that directly affect the development of the AF-EA.

Table 2. Public Law, Directives, and Instructions

Public Law	Date	Description
Government Performance and Reform Act (GPRA)	1993	Sets the stage for additional Information Resource Management reform
Clinger-Cohen Act	1996	Requires government agencies to develop and use architectures to integrate information technology with their business processes
E-Government Act of 2002	2002	Enhances the management and promotion of electronic government services and processes by providing a framework of measures and establishing a Federal CIO within the OMB
OMB Circular A-130	2002	States federal agencies that do not utilize an enterprise architectures in support of strategic planning will not receive federal funding
Directives	**Date**	**Description**
DoD Directive 5000.1	2003	Require all services to develop joint capability integrated architectures and DoD component functional area integrated architectures that are documented using the DoD Architecture Framework.
CJCSI 3170.01C	Draft	The instruction replaces CJCSI 3170.01B stating joint concepts and supporting architectures will serve as the basis for evaluating and approving all future joint and service capabilities proposals.
DoDI 8400.xx	Draft	It will require DoD Component architectures to be developed and maintained consistent with the Global Information Grid architecture, direct the use of the DoDAF, and implement a standard approach and data requirement for architecture development using the DoD Core Architecture Data Model.
Air Force Instruction (AFI) 33-124	2000	Supports the architecture-related mandates of the Clinger-Cohen Act of 1996, *Information Technology Management Reform Act*, and promulgates Air Force Enterprise C4ISR architecture products identified in the DoDAF.

To comply with this guidance the Air Force reviewed strategic plans, CONOPs, capability documents, and task list. From this review the Air Force Enterprise Architecture was broken into three distinct components. As seen in Figure 4, each functional area was identified as either a warfighting or support role (Fore, 2000). Moreover, the support role was further divided into combat and business support. The two mission areas, warfighting and support, were then leveraged to develop a supporting sub-architecture. To bridge these two architectures a third infostructure architecture was developed to ensure the three elements were capable of integrating their diverse requirements (AF Communications Agency, 2003).
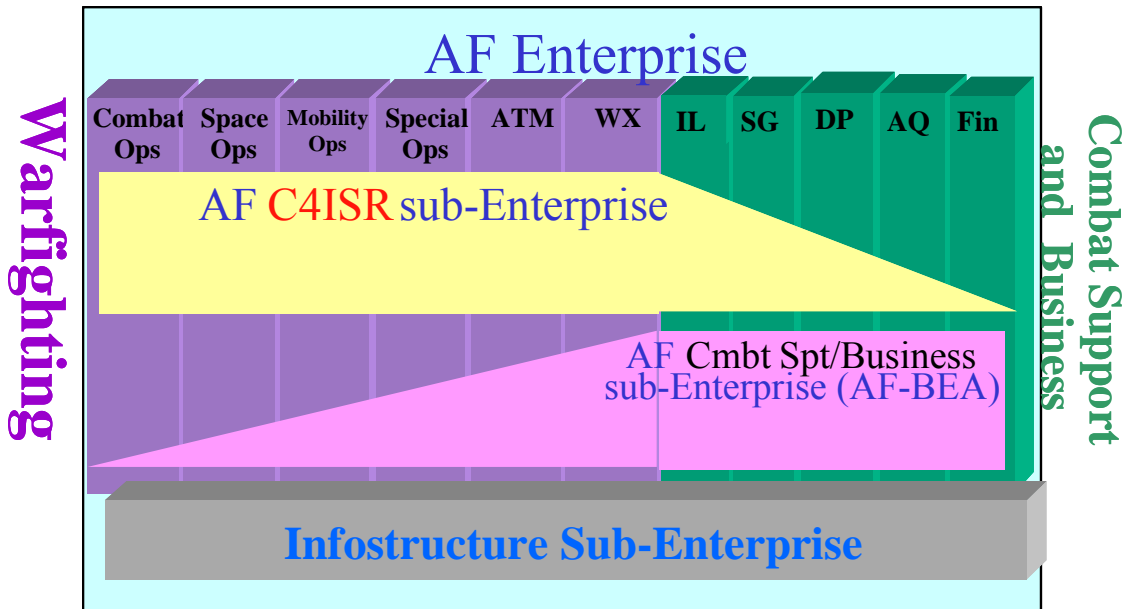
Figure 4. Air Force Enterprise

Perspectives

The side effect of developing the Air Force Enterprise Architecture was the creation of functionally oriented stakeholders. Therefore, three separate, but related categories of AF-EA products and artifacts have been developed. Each of the categories, see Figure 5, is comprised of components that are relevant to a particular group of stakeholders (AF Chief Architect's Office, 2003)**.**

Figure 5. Perspectives of the AF-EA

Uses and Impacts

Collectively, these perspectives allow the participants to utilize the architecture in multiple fashions. The following are examples of how the enterprise architecture is exploited to ensure the Air Force can achieve its core processes through capability based planning (AF Chief Architect's Office, 2003):

- **Supports the Planning, Programming, and Budgeting System (PPBS)**—the PPBS must allocate funds across competing programs and activities. To ensure the IT strategy provides the maximum benefit to the Air Force the AF-EA is used to provide the necessary context while making capability-based decisions.

- **Supports Joint Capabilities Integration and Development**—the joint capabilities integration and development process produces the warfighters' projected capability needs. During this process, information is required on the current and planned capabilities of existing information systems. The AF-AE provides this information by documenting system interdependencies, capturing the functionality resident in each existing or planned systems, and identifying gaps or deficiencies that prevent the AF from achieving critical capabilities or mission needs.

- **Supports the Acquisition Process**—The AF-EA guides and constrains system developers to ensure the resulting system is interoperable with the remainder of the systems and applications that make up the enterprise architecture.

- **Supports the Planning and Operations processes**—The AF-EA is also used to support warfighter contingency planning. The AF-EA gives Combatant Commanders a set of operational and system view products that define existing IT capabilities and

limitations. In addition, the AF-EA provides a basis for rapid reconfiguration of architectures to meet needs of contingency operations.

An overall description of the three separate components comprising the AF-EAF has been provided. The ultimate goal of providing this description is to determine how the Air Force defines its enterprise architecture. As stated before, the AF-EAF does not define the Air Force's enterprise architecture. Instead, the framework is only a tool used to present the various models, perspectives, and definitions for communicating the architecture's components. However, from this taxonomy the following operational definition of the Air Force Enterprise Architecture will be used for the purpose of this research:

The Air Force Enterprise Architecture is a tool that allows the vision, mission, and operational planning to be synchronized with programming, budgeting, and acquisition management to achieve the Air Force's strategic objectives.

As stated in Chapter 1, the implementation and management of the Air Force Enterprise Architecture has become the responsibility of the Air Force Communications Agency (AFCA). In response to this new mission, one of the actions taken by AFCA was to alter their SCOPE Network teams into SCOPE EDGE teams. While SCOPE Net's mission was strategic network advocacy SCOPE EDGE has increased AFCA's level of responsibility to include enterprise level assessment (Hoeft, 2004). The implications of this change in mission focus can be understood by taking a look back at this unit's formation and subsequent modification throughout its existence.

In 1968, the Air Force developed Project Scope Creek. The focus of this project was to apply "scientific methods to determine system capability, isolate faults, and make

corrections or modifications to make equipment perform "like new": (Air Force Communications Agency, 2004). In 1973, the success of this project lead to the application of these same scientific methods to systematically evaluate the Air Force's communication network.

Between 1973 and 1997 the Air Force experienced a growth in the need for data transport to meet the mission requirements of both the warfighter and combat support elements. By 1997, the large number of local area networks, metropolitan area networks, and wide area networks caused AFCA to revise the Scope Creek concept into Scope Network. The mission of this newly formed unit was to focus on network optimization (Air Force Communications Agency, 2004). To achieve this mission Scope Network developed and utilized a Network Maturity Model. This model provided a framework for assisting bases in developing more mature networks capable of meeting a base's mission requirements. From this framework Scope Network had the ability to assess a base network's current level of maturity and then determine the necessary requirements to optimize the base network (Air Force Communications Agency, 1998).

AFCA's requirement to implement and manage the Air Force Enterprise Architecture expanded Scope Network's view of the network as a collection of individual base networks to SCOPE EDGE's current view of the network as an enterprise (Hoeft, 2004). This new view has once again resulted in a change in mission focus from ensuring an individual base's network is optimized to ensuring the standardization of the Air Force networks.

As can be seen, even though AFCA's level of responsibility has expanded to include the entire Air Force Enterprise Architecture, SCOPE EDGE is currently focusing

on the network architecture. This technological perspective is operationalized by the continued used of the Network Maturity Model and SCOPE EDGE's mission statement (Air Force Communications Agency, 2004).

Strengthen enterprise standardization through compliance assessments, network optimization, reconstitution, and feedback into the Air Force network architecture. This focus only accounts for the technological view of the Air Force's Enterprise Architecture causing an emphasis to be placed on the hardware and software that comprise the enterprise architecture, but at the same time neglects all the other architecture views.

Theoretical Foundation

In 2002, the General Accounting Office (GAO) reported 52 percent of federal agencies have satisfied the requirement for developing enterprise architectures. However, only four percent report of all the federal agencies satisfied the management practices necessary for effective enterprise architecture management (General Accounting Office, 2002). In response, the GAO recognized that the ability to effectively manage an enterprise architecture's development, maintenance, and use depends upon having meaningful measures of that activity in relation to some standard (General Accounting Office, 2003).

The ability to measure the salient issues when managing the enterprise architecture permits managers to assess progress toward the desired end and to take corrective action to address unacceptable deviations. Ross defines the desired end as the objectives of the enterprise architecture specifying what the architecture enables the

business to do (Ross, 2003). Prior studies assessed the ability to use a Capability

Maturity Model as a tool to measure the level of maturity of an organization's enterprise

architecture (Thow-Yick, 1993; Patnayakuni and Rai, 2002; Jeffery and Leliveld, 2004).

The question remains, within the capability maturity model what are the main

issues that must be addressed to effectively manage an enterprise architecture. An

attempt was made by the OMB to answer this question by presenting an assessment

framework consisting of three components: 1) hierarchical stages of management

maturity, 2) categories of attributes that are critical to the success in managing any

endeavor, and 3) elements of EA management that form the core of the EA management

practice (General Accounting Office, 2003).

In contrast to this framework, Ross contends the process of developing an

enterprise architecture is not an orderly endeavor. Instead, she identifies four progressive

competency stages that an organization must achieve to effectively manage their

enterprise architecture (Ross, 2003). Allen and Boynton reached a similar conclusion by

addressing how information systems architecture can be used to support organizations.

They reviewed two architectural solutions' benefits and pitfalls. In the end, they contest

neither enterprise architecture will succeed on its own. Instead, firms must combine

elements of both to meet the challenges of integrating their information technology with

organizational strategy and structure (Allen and Boynton, 1991).

These two research efforts point to the fact that there are variations in the results

of utilizing an enterprise architecture. In support of this claim, Chalmeta and Campos

found that each enterprise architecture must be adapted to the needs of the organization

(Chalmeta, Campos et al., 2001). Therefore, managing an enterprise architecture is not a

stable process as presented in OMB's Enterprise Architecture Capability Maturity Framework. Instead, this process is an ongoing effort to rationalize, integrate, and optimize the information system capability within the organization across many projects and business units (Fong Boh, Yellin et al., 2003).

Within this ongoing effort, an organization's ability to effectively manage an enterprise architecture is directly influenced by its ability to reach a competency level where information system capabilities shape the organization's strategy. At the same time, the organization's strategy must be able to mold information system capabilities in response to changes in the market conditions and organizational realities (Ross, 2003). To reach this level an organization can either employ a capability maturity model or focus on improving its competency. However, using either approach requires the identification of the key issues to successfully managing an enterprise architecture. To date the current stream of research has not identified these key issues involved in the successful management of an enterprise architecture or the underlying factors driving these issues.

Therefore, the focus of this research is twofold. First, it will fulfill the identified academic void. Furthermore, as the Air Force Communication Agency takes on its new mission this research provides them with a guidepost that can be utilized to broaden their focus from only the network architecture to a holistic perspective. This new perspective will assist AFCA by identifying the key issues and their respective underlying factors to effectively manage the Air Force's Enterprise Architecture.

Summary

This chapter provided a contextual understanding of an enterprise architecture. Then the Air Force's definition of an enterprise architecture was provided. Finally, a theoretical discussion explained the background knowledge required to understand how prior research efforts led to the motivation to complete this current study.

III. Methodology

Methodology Overview

As with any research, the researcher preserved a balance between maintaining a realistic perspective and ensuring control over the selected methodology (Mason, McKenney et al., 1997). The researcher established the realistic perspective in Chapter 2 by providing an account of the development of the enterprise architecture concept. This was followed up with a historical account of the implementation of both the Department of Defense's and the Air Force's enterprise architecture. Providing this context served as the necessary background information to formulate answers to the following investigative questions:

1. What is an enterprise architecture?

2. How does the Air Force define its enterprise architecture?

To answer both of these questions the researcher had to gather evidence, determine patterns, and then develop an agreed upon operational definition for the purpose of this research (Mason, McKenney et al., 1997). The evidence consisted of academic literature, government reports, Air Force instructions, and policies. Each of these was reviewed and through triangulation patterns were identified. These two steps allowed the researcher to reach an operational definition of the two investigative questions.

The literature review also explained how prior research efforts have only identified issues leading to the success or failure of developing and implementing an

enterprise architecture. However, this body of knowledge has not addressed how to manage an enterprise architecture once it is in place.

Research Strategy

Creswell states, if a concept needs to be understood because little research has been done on it, then it merits a qualitative approach (Creswell, 2003). The concept under study is identifying the key issues affecting the Air Force's ability to manage its enterprise architecture. Qualitative research can never capture objective reality; as a result, the use of mixed methods, or triangulation, reflects an attempt to secure an in-depth understanding of the phenomenon in question (Denzin and Lincoln, 2000). This research secures an in-depth understanding of the phenomenon in question by utilizing quantitative data to assist in the interpretation of qualitative findings (Creswell, 2003). In short, the use of a mixed method research strategy not only identifies the key issues, but also reveals the most relevant ones.

The selected mixed method consists of two separate phases. The first phase encompasses a qualitative content analysis to identify, categorize and synthesize literature pertaining to enterprise architecture, enterprise infrastructure, systems development, and strategic data planning. By using a coding schema, a systematic examination of the data was conducted to identify core consistencies or themes (Patton, 2002) and answer the third investigative question of this study:

3. What does the literature identify as the issues that must be addressed to effectively manage an enterprise architecture?

Once the issues were identified, they were evaluated using relevant statistical measurements in an effort to make inferences about the qualitative findings. Therefore, the second phase included an interpretation of the overriding themes, which should answer the final two investigative question of this study:

4. Which issues have the most relevance?

5. What does the literature identify as the underlying factors driving these issues?

By employing this two-phased mixed method, the key issues affecting the Air Force's ability to manage its enterprise architecture are identified and analyzed. The remainder of this chapter explains the deductive process of selecting this sequential exploratory research strategy and the methodology employed to achieve the researcher's overall objective.

Mixed Method Approach

Determining which mixed method to employ for this research required four questions to be answered (Creswell, Plano et al., 2003):

1. What is the implementation sequence of the quantitative and qualitative data collection in the proposed study?

2. Is priority given to the quantitative or qualitative data collection and analysis?

3. At what stage in the research project is the quantitative and qualitative data and findings integrated?

4. Was an overall theoretical perspective used in the study?

As seen in Figure 6 below, the answers to the questions will form a "path" across the decision matrix. This "path" then determines the appropriate strategy. This section

explains how this decision tool was applied to surmise which mixed method research strategy to employ.

Question 1: Implementation	Question 2: Priority	Question 3: Integration	Question 4: Theoretical Perspective
No Sequence Concurrent	Equal	At Data Collection	Explicit
Sequential-- Qualitative first	Qualitative	At Data Analysis	
Sequential-- Qualitative first	Quantitative	At Data Interpretation	Implicit
		With Some Combination	

Figure 6. Decision Matrix for Determining Research Strategy

Question 1: *Implementation Sequence*

The data was collected in two distinct phases. First, the qualitative analysis was completed to explore the topic. Once the issues were identified, a further understanding of which issues were most relevant was completed through a quantitative analysis. Therefore, the implementation occurred sequentially, from qualitative to quantitative.

Question 2: *Priority*

According to Creswell, the second question determines "whether greater priority was given to the qualitative or quantitative approach" (Creswell, 2003). Before assigning the priority a research paradigm had to be determined. The initial framework for the research strategy was established by examining what this study aims to discover (Titscher, Meyer et al., 2000). There is no preexisting body of knowledge discussing how an enterprise architecture should be managed; therefore, an exploratory research strategy was selected.

Since the research paradigm warrants an exploratory effort, this study requires interpretative procedures whose goal is the clarification of ideas or concepts and/or the development of theoretical assumptions (Titscher, Meyer et al., 2000). Leedy and Ormrod state a qualitative approach should be selected when developing new insight or perspective about a phenomenon (Leedy and Ormrod, 2001). Therefore, the priority was placed on the qualitative approach.

Question 3: *Integration*

Even though the priority was placed on a qualitative approach, one of the purposes of this research effort was to identify which issues are the most relevant. To achieve this objective the qualitative findings are quantitatively analyzed and interpreted in Chapter 4. Given that the two phases do not overlap, support is given to the decision to implement a sequential data collection methodology (Creswell, 2003).

Question 4: *Theoretical Perspective*

The literature review described reports from the United States General Accounting Office who has developed an enterprise architecture Capability Maturity Management Module (Schekkerman, 2001; General Accounting Office, 2003). However, an exhaustive review of the top ten journals from the Management Information Systems field of study did not identify a theoretical framework supporting this module. Neuendorf states (Neuendorf, 2002):

> When existing theory or research literature cannot give a complete picture of the message pool, the researcher may take a more practical approach. The researcher may need to immerse himself or herself in the world of the message pool and conduct a qualitative scrutiny of a representative subset of the content to be examined. In this

way, variables emerge from the message pool, and the investigator is well grounded in the reality of the messages. Quite simply, the researcher needs to go native.

From Neuendorf's recommendation's an explicit theoretical framework was not used to guide this research effort. Instead, a theoretical "lens" assisted in determining what issues were important to examine (Creswell, 2003). From this "lens", an inductive procedure was followed to create an emergent model that could be used to identify the key issues in effectively managing an enterprise architecture. Therefore, the mixed method used an implicit theory with the intent to allow the issues to emerge from the selected data set.

The four questions were answered by scrutinizing the objective of this research. Figure 7 summarizes these answers by shading in the cells for each response. These cells form a "path" leading to the selection of the appropriate research strategy.

Question 1: Implementation	Question 2: Priority	Question 3: Integration	Question 4: Theoretical Perspective
No Sequence Concurrent	Equal	At Data Collection	Explicit
Sequential-- Qualitative first	Qualitative	At Data Analysis	
Sequential-- Qualitative first	Quantiative	At Data Interpretation	Implicit
		With Some Combination	

Figure 7. Decision Choices for Determining Research Strategy

The "path" created requires qualitative data to be present prior to the quantitative analysis. In addition, the main focus of the research is identifying the qualitative themes present in the data. Only after these themes are identified are they then interpreted.

Finally, the research paradigm is exploratory in nature since no preexisting theories are present in the current body of knowledge.

Answering these four questions allowed the researcher to focus on the necessary criteria to determine the appropriate research strategy. Furthermore, from this strategy a methodology is laid out to achieve the objective of this research. Figure 8 was created by drawing on each individual answer in the decision matrix to determine the required "path" of events to conduct this research.

Qualitative Data Collection	→	Qualitative Data Analysis	→	Quantitative Data Collection	→	Quantitative Data Analysis	→	Interpretation of Data Analysis
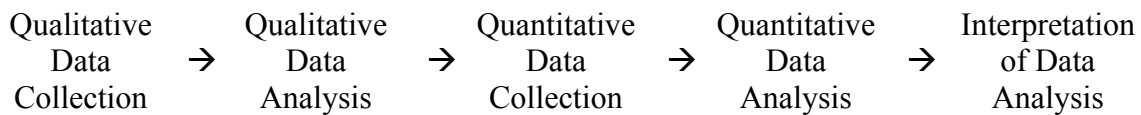
Figure 8. Research Method Strategy

This "path" leads directly to the utilization of a sequential exploratory research strategy (Creswell, 2003). The remaining sections explain the methodology utilized to carry out the selected research strategy.

Methodology

The data for this research originates from written text discussing the concepts of enterprise architecture, enterprise infrastructure, systems development, and strategic data planning. Denzin and Lincoln suggests that a content analysis is an acceptable research methodology for this type of data (Denzin and Lincoln, 2000). Leedy and Ormrod agree that a content analysis is the systematic examination of written documents "for the purpose of identifying patterns, themes, or biases" (Leedy and Ormrod, 2001). Therefore, to carry out this research's methodology a content analysis was performed.

In conducting the content analysis, a prescribed process was followed. First, the content characteristics to be measured were specified. Then rules were established to identify and record the characteristics of interest. Finally, a quantitative statistical analysis was carried out to determine if the findings converge or diverge on these characteristics. The researcher employed Neuendorf's nine-step framework to carry out this process (Neuendorf, 2002). The sequence of steps prescribed by Neuendorf's framework were modified to reflect the actions taken by the researcher. By explicitly explaining how the content analysis was conducted, future academic studies will be able to accurately replicate the study. The steps were:

1) Theory and Rationale

2) Sampling

3) Conceptualization Decisions

4) Coding Schemes

5) Operationalization Measures

6) Training and Initial Reliability

7) Coding

8) Final Reliability

9) Tabulation and Reporting

Step 1: *Theory and Rationale*

To generate data sources for this research effort two separate steps where taken to identify relevant literature in the fields of enterprise architecture, enterprise infrastructure, systems development, and strategic data planning. This section explains what sources of literature were selected and answers the question: Why were they selected?

Developing an Information Architecture has been identified as one of the top ten management issues by senior IS executives since 1987 (Brancheau and Wetherbe, 1987; Niederman, Brancheau et al., 1991; Brancheau, Janz et al., 1996). Nord and Nord identified *Communications of the ACM*, *Decision Science, Information and Management, Information Systems Management* (changed name from *Journal of Information Systems Management*)*, Journal of Computer Information Systems, Journal of Management Information Systems, Journal of Systems Management, Management Science*, and *MIS Quarterly* as journals that are considered to publish important research (Nord and Nord, 1995). *Information Systems Research* was added to this list because it was recognized by two other research efforts as a "top tier" journal (Walstrom, Hardgrave et al., 1995; Hardgrave and Walstrom, 1997).

In the first step taken to identify relevant literature each top tier journal was reviewed. Nord and Nord state these academic journals publish important research; therefore, the journals should contain articles covering the top management issues. As stated above, developing an architecture was one of the top management issues from 1987 to the present day. Therefore, the title and abstract of each article published from 1987 to August 2004 by these ten academic journals was reviewed. If the research focus of the individual article dealt with enterprise architecture, enterprise infrastructure, and/or strategic planning it was included in the content analysis.

Step 2: *Sampling*

During the first round of reviews only 12 research studies were identified that dealt with enterprise architecture and/or enterprise infrastructure. Due to the minimal amount of articles identified during the initial review, this step was repeated. However,

during the second search of the same set of academic journals articles were included in the content analysis if the research focus dealt with strategic planning, IS planning, system integration, systems development and/or strategic use of information systems.

Nord and Nord reported there was the potential for significant bias in establishing which journals should be rated as "top tier" (Nord and Nord, 1995). In addition, there were a limited number of articles identified during the first review of the top tier IS management journals. Consequently, the key words from the academic articles identified in the first review were used to search for additional articles. The following keywords were used in the search parameters of an academic library search engine and various online sources: enterprise architecture, infrastructure, IS planning, information technology strategy, and system integration.

This second step randomly designated academic articles, government and commercial reports, and white papers for possible inclusion in the content analysis. Any article dealing with enterprise architecture, enterprise infrastructure, strategic planning, IS planning, system integration, and strategic use of information systems were added as a data source. The expanded review of the top IS management journals and the online search resulted in identifying exactly 100 more articles.

In total, the separate searchers allowed the primary researcher to identify 112 articles for possible inclusion in the content analysis. Each article's title, abstract, introduction, and conclusion was reviewed to determine if the data source should be retained for the study. This review paired down the total number of articles used during the content analysis from 112 to 52.

Step 3: *Conceptualization Decisions*

As stated in Chapter 2's literature review, there is no existing theory stating how an enterprise architecture should be managed. As a result, there was no explicit theory used in the selection of the content analysis variables. However, the literature review recognized Zachman's development of an enterprise architecture framework. This framework focused on four key areas to include: process, data, control, and technology (Zachman, 1987). Therefore, these four categories were used as a theoretical perspective to identify management issues throughout the body of knowledge. How the issues were identified and validated is discussed in the next section.

Step 4: *Coding Schemes*

An emergent process of variable identification was employed to identify the issues that must be addressed by the Air Force to effectively manage its enterprise architecture. As each article was read by the primary researcher, the major issues were noted on a separate sheet of paper. The section of the article from which the issue was extracted was highlighted and a comment was inserted into the margin of the article. This enabled the researcher to match the notes to the context of the article if required while developing the codebook or during the process of coding the written text. This was completed for all 52 articles.

In utilizing the emergent process of variable identification, 36 separate issues were recognized during the review of the 52 articles. By utilizing the theoretical perspective of Zachman's Framework, four main categories were created in the codebook to include: process, data, control, and technology. Due to the significant number of issues under the control category this was further broken down into three separate

categories which are development control, operational control, and maintenance control. Finally, two additional categories emerged while reviewing the notes created by the primary researcher. These two categories are flexibility and openness. A codebook was then developed by placing issues under the category to which it was related. The primary researcher then reviewed each article's highlighted sections and the corresponding notes to make sure the issues were not taken out of context in developing the codebook. The codebook matrix is located in Appendix B: Codebook.

Since identifying thematic units requires significant interpretation to code properly (Lacity and Janson, 1994), four co-researchers were each assigned a subset of the 52 articles to address the potential for personal bias and to prevent errors of judgment and misinterpretation of the text. The co-researchers were instructed to review each article to ensure the primary researcher had not misinterpreted the identified issues. If there was disagreement between the primary researcher and co-researcher the section of the article was read together and the issue was discussed until they agreed upon the interpretation of the issue. The co-researcher was also directed to review each of the issues listed in the codebook to make sure the issue was clear and concise to avoid any potential misinterpretations during the content analysis. Any pertinent recommendations for improving the codebook were incorporated by the primary researcher. Other than syntax corrections, the only major modification made was combining two issues that proved to be redundant bringing the total number of emergent issues to 35.

The four co-researchers all had the same operational and academic experience as the primary researcher. Just as the primary research, all four co-researchers are Information Resource Management students enrolled at the Air Force Institute of

Technology. Furthermore, both the primary researcher and each of the selected co-researchers are 1st Lieutenants in the Air Force and have held one prior assignment as a Communications and Information Officer before being assigned as a Master's Degree Student at Wright Patterson Air Force Base, Ohio.

Step 5: *Operationalization measures*

The unit of analysis is each of the identified 35 issues. However, each of the identified issues did not appear in every article. Instead, if the issue was determined to be present while reviewing the article a number one was marked on the codebook matrix. No mark was made on the matrix if the issue was not present in the article. No weight was added due to the author's level of expertise or the source of the document being reviewed. The codebook matrix provided to each coder is referenced in Appendix B: Codebook.

Step 6: *Training and initial reliability*

Twenty-four coders analyzed the articles selected for the content analysis. The coders were enrolled in the Enterprise Architecture class at the Air Force Institute of Technology. All of the subjects are pursuing their master's degree in the Systems and Engineering Management Department.

To prepare the coders for the content analysis a training session was held to ensure they understood how to use the codebook and how to identify the issues contained in their assigned articles. The primary researcher did not explain the purpose of the study to the coders to reduce the bias that would compromise validity (Neuendorf, 2002). A subsample of three articles was selected from the pool of documents to run a pilot test with the 24 coders. An assessment of the coders was carried out to develop a "valid,

reliable, and useful coding scheme" by considering three diagnostic measures (Neuendorf, 2002).

1. The identification of problematic measures

2. The identification of problematic categories

3. The identification of problematic coders

After the pilot study was completed, each of the measures listed above was assessed. This was completed to determine if changes in the codebook was necessary and/or if the coders required addition training. This technique was used to establish intercoder reliability by ensuring all 24 coders have the same understanding of the coding scheme (Neuendorf, 2002). The results and interpretation of the pilot study are reported in Chapter 4.

Step 7: *Coding*

The primary researcher coded all of the articles included in the content analysis by recording the results on the codebook matrix. As stated above, to reduce the influence of personal bias four co-researchers validated these findings for their assigned subset of articles.

The coders consisted of students enrolled in the Enterprise Architecture course for the Fall 2004 quarter. From these 24 students two groups of 12 were established to determine if educational or vocational experience confounded the outcome of the results. The first group of 12 students consisted of 11 Majors enrolled in the Intermediate Development Education (IDE) program and one Captain in his second to last quarter before graduation. The second group comprised 12 students who were in their first

quarter of classes in pursuit of their Master's degree in the Systems and Engineering Management Department.

Each of the 24 coders was assigned one identical article to measure for inter-coder reliability (Neuendorf, 2002). Then the two groups of twelve were each broken down into groups of two students each to create a total of 12 groups. One student from the IDE program was assigned the exact same articles as one student from the Information Resource Management program. This created twelve paired groups between the two programs of study.

Each of the twelve groups were assigned a total of five articles. Four articles were randomly assigned to each member of each group and the fifth article assigned to every coder served as the required overlap as discussed above. Once the articles were assigned to each member within the groups, the individual coders were instructed to annotate their results on the codebook that had been provided.

Step 8: *Final Reliability*

Weber asserts: "To make valid inferences from the text, it is important that the classification procedure be reliable in the sense of being consistent: different people should code the same text in the same way." Weber continues to discuss the issue of reliability by stating "problems usually grow out of the ambiguity of word meanings, category definitions, or other coding rules"(Weber, 1990). The following two types of reliability are pertinent to content analysis:

a. Stability – Addresses how consistent the results of the content classification are over time.

b. Reproducibility (inter-coder consistency) – Determines if the content classification produces matching results when the identical text is coded by more than one person.

As mentioned in Step 7, the 24 coders were divided into two groups. Then one coder from each group was randomly paired up with a coder from the other group. Each pair of coders was then assigned the exact same five articles to analyze. To confirm the stability of the coding schema an independent t-tests was performed to determine if the average percent agreement for each group of two coders was or was not statistically different.

Reproducibility is addressed by measuring the agreement between each of the coders and the primary researcher. The use of the appropriate reliability coefficient calculation is important. However, if the coders are consistently making incorrect judgments about the presence or absence of the issues in the article being coded the level of reproducibility will be negatively affected (Kolbe and Burnett, 1991). The primary researcher improved the reproducibility of this research by placing emphasis on improving the operational procedures used to properly code the content analysis articles. Focusing on the underlying classifications scheme, the operational definitions for coding categories, and the directions that guide the coding process directly improves the quality of judgment-based data (Perreault and Leigh, 1989).

To measure the strength of the research method employed a coefficient of agreement calculation was completed. The coefficient most commonly used in content analysis due to its applicability and ease of use is percent agreement (Perreault and Leigh, 1989; Kolbe and Burnett, 1991; Neuendorf, 2002). Conversely, this coefficient has been

identified as having the potential to over-inflate the level of agreement due to "chance agreement" (Neuendorf, 2002). Chance agreement is directly impacted by the number of coding decisions. As the number of issues in the codebook increases the probability of chance agreement decreases (Perreault and Leigh, 1989; Kolbe and Burnett, 1991).

Since this research had 35 issues, chance agreement was not seen as a confounding factor. Therefore, percent agreement was selected as the inter-rater reliability coefficient. An agreement is defined as the two judges, the primary researcher and the coder, found the issue in the article or if both of them agreed the issue was not present in the article. For both the pilot and full study the percent agreement for each of the 24 coders was calculated twice.

First, the coder's overall level of agreement with the primary researcher was measured. This was accomplished by totaling the number of agreements for each of the articles coded then dividing by the total number of issues (36 for the pilot study and 35 for the full study). Then the coder's percent agreement average was computed for all the articles coded (3 articles for the pilot study and 5 articles for the full study). However, according to Neuendorf, reliability coefficients must be reported separately for each and every measured variable (Neuendorf, 2002). Therefore, the second percent agreement measurement calculated the coder's level of agreement for each issue. To calculate this figure the total number of agreements was divided by the number of articles coded. Once again the coder's percent agreement average was computed across all of the issues.

Each coder's two measurements of percent agreement were then plotted on a separate histogram. These two distributions allowed the researcher to calculate a confidence interval for the computed level of percent agreement. From these two

confidence intervals, the overall reliability between the judges was established allowing the primary researcher to make inferences about the results.

Step 9: *Tabulation and Reporting*

The final step of Neuendorf's framework determined which of the 35 emergent issues were the most relevant. To make this determination the primary researcher calculated the overall level of presence of each of the identified themes across the 49 articles included in the content analysis. The themes with the highest frequency levels were determined to be the most relevant issues the Air Force must focus on to successfully manage its enterprise architecture. This answered the fourth investigative question of this research:

4. Which issues have the most relevance?

The identified issues were then further analyzed to identify trends and consistent themes. This analysis answered the fifth investigative question:

5. What does the literature identify as the underlying factors driving these issues?

Research Strategy Limitations

The selected research strategy introduced some limiting factors that may affect the results of this study. In a content analysis the researcher is a key instrument (Leedy, 2001). This causes the results to be confounded by the inescapable human nature of the researcher. For example, the article analysis is inherently subjective. Therefore, the results may be impacted by external variables.

Another limitation is the content analysis selectively identified latent issues. This allowed the subjective judgment of the primary researcher to be introduced in the

development of the coding schema. Therefore, the schema may not be representative of the identified articles, limiting the ability to generalize about the findings to a larger population of articles.

Summary

A methodical approach was taken in choosing the appropriate research strategy required to answer the five investigative question of this research. By selecting a sequential exploratory research strategy, quantitative data was used to interpret the qualitative findings from the content analysis. This enabled the researcher to identify the most relevant issues the Air Force must focus on to effectively manage its enterprise architecture.

IV. Results and Analysis

Overview

  The purpose of this chapter is to present the answers to the following five investigative questions:

1. What is an enterprise architecture?

2. How does the Air Force define its enterprise architecture?

3. What does the literature identify as the issues that must be addressed to effectively manage an enterprise architecture?

4. Which issues have the most relevance?

5. What does the literature identify as the underlying factors driving these issues?

  The first two questions will be answered by recounting the operational definitions as expounded upon in Chapter 2's literature review. Then a description of the analyzed articles is presented. Prior to presenting the results of the content analysis the measurement instrument's validity and reliability is established by presenting the results from both the pilot and the full study. The instrument is then utilized to answer the final three investigative questions. Finally, the answers to these questions are discussed to reach the overall goal of this research.

Operational Definitions

  In Chapter 2, the researcher provided an account of the development of the enterprise architecture concept. This was followed up with a historical account of the implementation of both the Department of Defense's and the Air Force's enterprise

architecture. Providing this context served as the necessary background information to formulate answers to the first two investigative questions:

1. What is an enterprise architecture?

2. How does the Air Force define its enterprise architecture?

To answer both of these questions the researcher gathered evidence, determined patterns, and then develop an agreed upon operational definition for each question (Mason, McKenney et al., 1997). First, through the review of academic literature the researcher was able to identify common themes resulting in the following operational definition of an enterprise architecture:

The organization of computing resources in an organization, which consists of data, information, applications, infrastructure, and personnel to enable a firm's business strategy.

The purpose of this research was to assist the Air Force Communications Agency by identifying the key issues to effectively manage the Air Force's Enterprise Architecture. Therefore, the next logical step was to identify an operational definition for the Air Force's Enterprise Architecture. A description of how the Air Force's Enterprise Architecture Framework was created was presented in Chapter 2. From this description the researcher was able to present the following operational definition for the Air Force's Enterprise Architecture:

The Air Force Enterprise Architecture is a tool that allows the vision, mission, and operational planning to be synchronized with programming, budgeting, and acquisition management to achieve the Air Force's strategic objectives.

Sample

The data set for this research consisted of 52 articles. Among these articles 19 originated in practitioner journals, two in government reports, 8 in white papers, and the remaining 23 appeared in peer-reviewed academic journals. The peer-reviewed articles consisted of nine case studies, four comparative analysis, three developmental studies, three surveys, and three Delphi studies.

Validity of Measurement Instrument

To increase the level of objectivity of the coding process the primary researcher addressed shortfalls in the creation and operationalization of the measurement instrument. Once the initial coding schema had been created an independent review was completed to remove the primary researcher's personal bias. In addition, the 24 coders completed a pilot study to determine if the coding schema and/or provided directions required any modifications. The following two sections explain the results and steps taken to improve upon the measurement instrument's validity.

Issue Validation

As stated in Chapter 3, an emergent process of variable identification was employed by the primary researcher to identify the issues that must be addressed to manage an enterprise architecture. The emergent process of variable identification resulted in 36 separate issues to be recognized during the review of the 52 articles. This process does not allow the intricacies of human nature to be removed leading to personal bias, errors of judgment, and misinterpretation of the text.

Therefore, four co-researchers were each assigned a subset of the 52 articles to address the potential for misinterpreted the identified issues. Each co-researcher was given 13 articles to review. Amongst the four co-researchers, only two of them disagreed with the primary researcher in regards to the presence of an issue within an article.

The first of these two co-researchers had identified four separate articles with only one disagreement per article. The primary researcher and the co-researcher discussed each individual disagreement and on three of the them the two individuals came to agreement concerning the proper interpretation of the text. These agreements led to the primary researcher removing the annotation that the issue was present in the article in question for each of the three articles. On the fourth article, both researchers agreed the issue was present leading to making no changes to the annotation on the coding schema that the issue was present.

The other co-researcher who disagreed with the interpretations of the primary researcher disputed three issues spanning two articles. Once again the two researchers discussed the disagreements leading to an agreement that the issues were present in the articles. This resulted in making no changes to the annotation on the primary researcher's coding schema.

The four co-researchers also reviewed the coding schema to check for syntax or spelling errors and to ensure there was no redundancy across the 36 issues. One of the co-researchers recommended combining two issues in the coding schema to reduce the possibility of misinterpretation during the content analysis. The two issues that were combined into one are the following:

- An interoperable architecture allows other systems to easily integrate into it--

systems can be moved in and out of the architecture

- Avoid intrusive integration by modifying code in legacy systems--use data brokers

to transform data from one format to another

These second issue was merged into the first resulting in one combined issue:

- An interoperable architecture allows other systems to seamlessly integrate with it,

allowing other systems to be moved in and out of the architecture

Any pertinent recommendations for improving the codebook were incorporated by the primary researcher. This ensured the issues listed in the coding schema were clear and concise to avoid any potential misinterpretations during the content analysis. This independent review resulted in removing the personal bias of the primary researcher and increasing the level of objectivity in coding the content analysis articles.

Instrument Validation – Pilot Study

A sub-sample consisting of three of the 52 articles was selected to conduct a pilot study. Each of the 24 coders independently coded each article included in the sub-sample. This pilot study was conducted to develop a "valid, reliable, and useful coding schema" by considering three diagnostic measures (Neuendorf, 2002):

1.   The identification of problematic measures

2.   The identification of problematic categories

3.   The identification of problematic coders

The assessment of these three measures and the action taken by the primary researcher to further develop the coding schema is explained in the next four sections.

Diagnostic 1: *Problematic Measures*

To identify problematic measures the percent agreement for each article amongst the 24 coders and the primary researcher was computed. The overall percent agreement for each article was calculated by dividing the total number of agreements by the total number of issues. Then each coder's average percent agreement amongst the three articles was determined. The 24 percent agreement averages were then inputted into JMP© version 5.1. This program was utilized to produce the histogram and statistical measurements presented in Figure 9 and Figure 10 below.
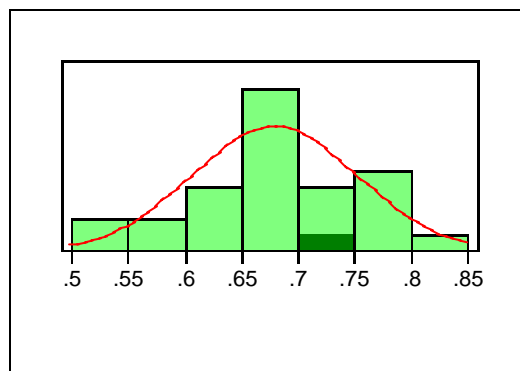
Figure 9. Pilot Study Average Article Agreement per Coder

Mean	0.680225
Std Dev	0.0732694
Std Err Mean	0.0138466
upper 95% Mean	0.7086359
lower 95% Mean	0.6518141
N	28

Figure 10. Pilot Study Article Agreement Statistical Measurements

As shown in Figure 10 above, the mean for the coders' average percent agreement is 68.02%. The distribution appeared to be normally distributed and the Shapiro-Wilk test, a statistical test for normality, supported this claim. The Shapiro-Wilk test evaluated the following two hypotheses at a significance level of 0.05:

H_o: The distribution is normally distributed

H$_a$: The distribution is not normally distributed

The reported p-value was 0.7627, causing the primary researcher to fail to reject the null hypothesis, supporting the claim the histogram was normally distributed. Therefore, the confidence interval can be used to infer the coders will have an average percent agreement between 70.86% and 65.18% for this sub-sample of articles 95% of the time. Nine coders scored above the upper bound and seven coders scored below the lower bound. To identify problematic measures the seven coders who scored below the lower bound percent agreement for each article was examined. Four of the coder's lowest score occurred on the third article, two on the second article, and one on the first article.

Since over 57% of the coders lowest score occurred on the third article the mean was calculated for all 24 coder's assigned articles. As shown in Table 3 below, the mean score for Article 3 is 60.80%.

Table 3. Pilot Study Article Mean Scores

Article 1		Article 2		Article 3	
Mean	0.7202	Mean	0.7027	Mean	0.6080

This score is well below the 95% confidence interval's lower bound. Each coder was assigned the same three articles. In addition, every article was identified by the same numbering system. Therefore, the ability to properly analyze article three was identified as problematic.

Diagnostic 2: *Problematic Categories*

The second diagnostic measure examined the average percent agreement per issue for each of the 24 coders. This measure was calculated by adding up the total number of

agreements for each issue across the three articles. The sum was then divided by the

number of articles coded. Then an overall percent agreement was computed by averaging

all of the coders' respective scores per issue. The 36 percent agreement averages were

then inputted into JMP$^{©}$ version 5.1. This program was utilized to produce the histogram

and statistical measurements presented in Figure 11 and Figure 12 below.
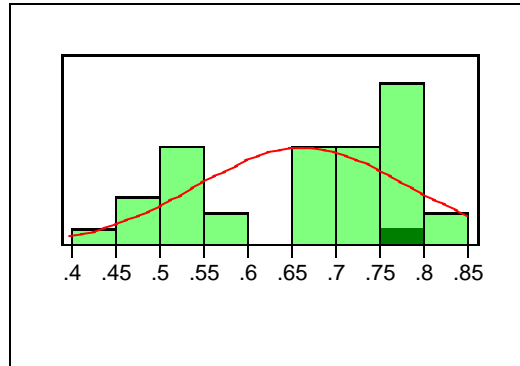
Figure 11. Pilot Study Agreement per Issue

Mean	0.6643889
Std Dev	0.1207385
Std Err Mean	0.0201231
upper 95% Mean	0.7052409
lower 95% Mean	0.6235369
N	36

Figure 12. Pilot Study Agreement per Issue Statistical Measurements

As shown in Figure 12 above, the mean for the overall percent agreement for all

the issues is 66.44%. The distribution does not appear to be normally distributed and the

Shapiro-Wilk test supported this claim. The Shapiro-Wilk test evaluated the following

two hypotheses at a significance level of 0.05:

H_o: The distribution is normally distributed

H_a: The distribution is not normally distributed

The reported p-value was 0.0101, causing the primary researcher to reject the null

hypothesis, supporting the claim the histogram was not normally distributed. Therefore,

the confidence interval could not be used to make inferences about the issues' average

percent agreement. However, the histogram appears to have two separate distributions

contained within it. The distribution located above the mean consisted of 24 issues. The

other distribution contained the remaining 12 issues. These 12 issues' average percent

agreements were all below the lower bound of the confidence interval. Thus, these 12

issues were identified as problematic.

Diagnostic 3: *Problematic Coders*

The identification of problematic coders was accomplished by re-analyzing the

measurement utilized to examine problematic issues. Instead of inspecting the percent

agreement for one issue across all the coders, the average percent agreement was

calculated across all the issues for each coder. This measurement allowed the primary

researcher to identify any potential rogue coders. The percent agreement per issue for

each coder had already been calculated during the previous diagnostic measurement.

Thus, the average percent agreement per coder was calculated by adding up each coder's

percent agreement scores for each issue and then dividing this sum by 36. The 24 percent

agreement averages were then inputted into JMP$^{©}$ version 5.1. This program was utilized

to produce the histogram and statistical measurements presented in Figure 13 and Figure

14 below.
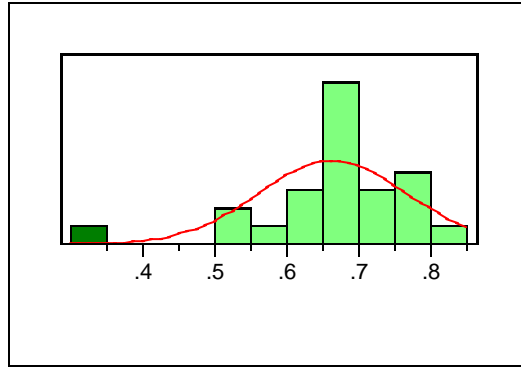
Figure 13. Pilot Study Student Agreement Across Issues

Mean	0.6650417͟
Std Dev	0.1046129͞
Std Err Mean	0.021354͟
upper 95% Mean	0.7092158͟
lower 95% Mean	0.6208675͟
N	24͟

Figure 14. Pilot Study Agreement Across Issues Statistical Measurements

As shown in Figure 14 above, the mean percent agreement across all the issues is 66.5%. The distribution appears to be normally distributed, but the Shapiro-Wilk test does not support this claim. The Shapiro-Wilk test evaluated the following two hypotheses at a significance level of 0.05:

H_o: The distribution is normally distributed

H_a: The distribution is not normally distributed

The reported p-value was 0.011, causing the primary researcher to reject the null hypothesis, supporting the claim the histogram was not normally distributed. An outlier value of 33.33% was excluded and the histogram and statistical measurements were regenerated. Figure 15 and Figure 16, located below, present the updated histogram and statistical measurements without the outlier measurement.
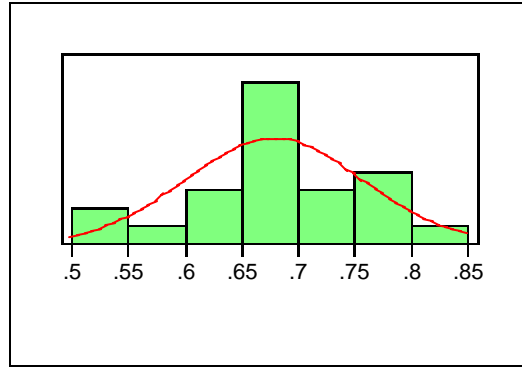
Figure 15. Pilot Study Outlier Removed

Mean	0.6794783
Std Dev	0.0788162
Std Err Mean	0.0164343
upper 95% Mean	0.7135609
lower 95% Mean	0.6453956
N	23

Figure 16. Pilot Study Outlier Removed Statistical Measurements

As shown in Figure 16 above, the mean for the coders' percent agreement across all the issues is 67.95%. The distribution appears to be normally distributed and the Shapiro-Wilk test supports this claim. The Shapiro-Wilk test evaluated the following two hypotheses at a significance level of 0.05:

H_o: The distribution is normally distributed

H_a: The distribution is not normally distributed

The reported p-value was 0.3386, causing the primary researcher to fail to reject the null hypothesis; supporting the claim the histogram is normally distributed. The regenerated confidence interval was then used to infer 95% of the time the remaining 23 coders' average percent agreement across all the issues will range between 71.36% and 64.54% for this sub-sample of articles. Five coders scored below the lower bound of the confidence interval bringing the total number of problematic coders to six.

Validation of Coding Schema

These three diagnostic measurements were then holistically reviewed to develop a "valid, reliable, and useful coding schema." This review allowed the primary researcher to make the necessary modifications to both the measurement instrument and the coders.

As was noted in the first and last diagnostic measurements, there were both problematic measures and problematic coders identified. To remedy these two issues the coders were given a second training session to explain how to properly analyze the articles and record their findings. Although the subjective judgment of the coders could not be entirely removed the repeated training was an attempt to nullify this confounding factor.

The second diagnostic measurement identified 12 problematic issues. Each issue was reviewed by the primary researcher to provide a more clear and concise definition of each of the issues. In addition, the coders provided comments to the primary researcher consisting of ways to improve upon the coding schema. The pertinent recommendations were incorporated into the instrument. The validated coding schema, located in Appendix C: Validated Codebook, replaced the original one for use in the full study.

Reliability of Measurement Instrument – Full Study

The validity of the issues included in the coding schema was established from the pilot study. The next step was to confirm the reliability of operationalizing the measurement instrument during the analysis of the remaining 49 articles. As stated in Chapter 3, Weber asserts: "To make valid inferences from the text, it is important that the classification procedure be reliable in the sense of being consistent—different people

should code the same text in the same way"(Weber, 1990). The following two types of reliability are pertinent to content analysis:

a. Stability – Addresses how consistent the results of the content classification are over time.

b. Reproducibility (inter-coder consistency) – Determines if the content classification produces matching results when the identical text is coded by more than one person.

The next two sections describe the analysis of these two types of reliability.

Stability

Stability is established by proving the same results are obtained in a renewed application of the measurement instrument to the same text (Titscher, Meyer et al., 2000). To confirm the stability of the instrument the 24 coders were divided into two groups. Then one coder from each group was randomly paired up with a coder from the other group. Each pair of coders was then assigned the exact same five articles to analyze.

For each coder, the average percent agreement for each issue was calculated across the five articles. This measure was calculated by adding up the total number of agreements for each issue. The sum was then divided by the number of articles coded. In addition, the overall percent agreement for each article was calculated by dividing the total number of agreements by the total number of issues. Then each coder's average percent agreement amongst the five articles was determined.

The two percent agreement measurements for the 12 coders in both of the groups were then used to create four separate frequency distributions, as shown in Figure 17.
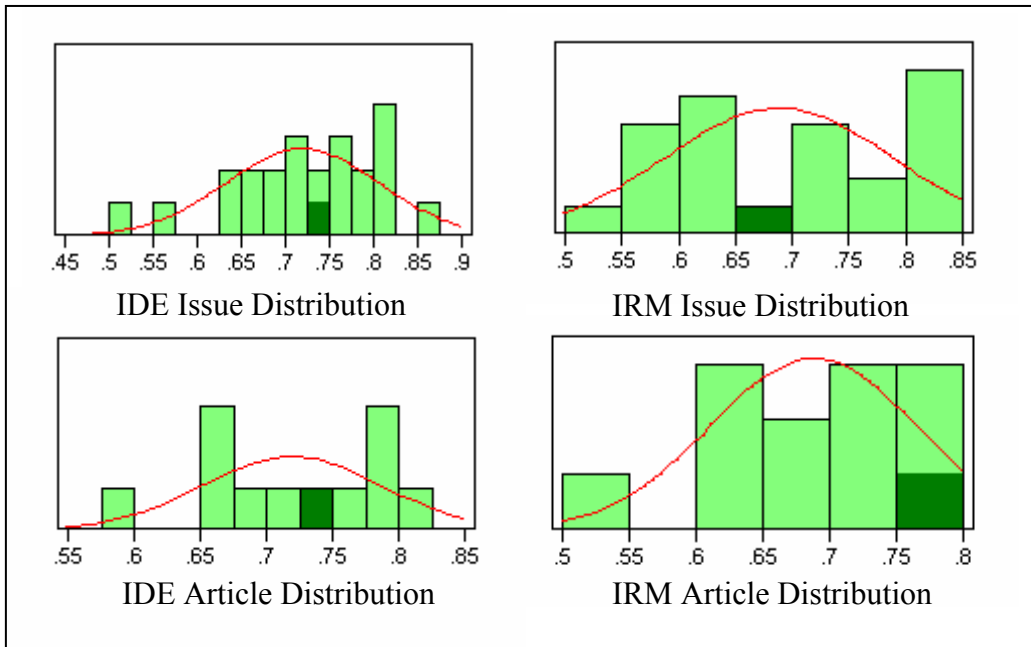
Figure 17. Two Groups' Percent Agreement Frequency Distributions

Each of these frequency distributions does not appear to be normally distributed.

However, the Shapiro-Wilk test was used to evaluate the four distributions against the

following two hypotheses at a significance level of 0.05:

H_o: The distributions are normally distributed

H_a: The distributions are not normally distributed

The p-value for each frequency distribution is presented in Table 4.

Table 4. Group Distributions P-values

Distribution	P-Value
IDE Issue Distribution	0.5642
IRM Issue Distribution	0.0804
IDE Article Distribution	0.4259
IRM Article Distribution	0.6492

The p-value for each percent agreement measurement was above the significance

level of 0.05. Therefore, the primary researcher failed to reject the null hypotheses,

supporting the claim that each distribution is normally distributed. In addition, each

group's population variances were examined to ensure they were approximately equal.

These characteristics allowed two independent t-tests to be performed to prove the

average percent agreement per issue and the average percent agreement across the articles

for each group of two coders was not statistically different.

The first independent t-tests compared Group 1's mean percent agreement per

issue, μ_1, to Group 2's mean percent agreement, μ_2. This test evaluated the following

two hypotheses at a significance level of 0.05 with a degree of freedom of 44:

H_o: $\mu_1 - \mu_2 = 0$

H_a: $\mu_1 - \mu_2 \neq 0$

The test statistic was calculated using the formula indicated below:

$$t = \frac{\mu_1 - \mu_2}{\sqrt{\left(\frac{1}{n_1} + \frac{1}{n_2}\right)s^2}} = \frac{0.0311304}{\sqrt{\left(\frac{1}{23} + \frac{1}{23}\right)0.0683103}} = 0.4039$$

The test statistic was between the critical values of $t_{\alpha=.05/2}$ = -2.3207 and 2.3207 causing

the primary researcher to fail to reject the null hypothesis. Therefore, the average percent

agreement per issue for each group was not statistically different.

The second independent t-tests compared Group 1's mean percent agreement

across the five articles, μ_1, to Group 2's mean percent agreement, μ_2. This test evaluated

the following two hypotheses at a significance level of 0.05 with a degree of freedom of

22:

H_o: $\mu_1 - \mu_2 = 0$

H_a: $\mu_1 - \mu_2 \neq 0$

The test statistic was calculated using the formula indicated below:

$$t = \frac{\mu_1 - \mu_2}{\sqrt{\left(\dfrac{1}{n_1} + \dfrac{1}{n_2}\right)s^2}} = \frac{0.0311667}{\sqrt{\left(\dfrac{1}{12} + \dfrac{1}{12}\right)0.1153065}} = 0.0.224822$$

The test statistic was between the critical values of $t_{\alpha=.05/2} =$ -2.4055 and 2.4055 causing

the primary researcher to fail to reject the null hypothesis. Therefore, the average percent

agreements across the five articles were not statistically different. The results from these

two tests establish the stability of the coding schema by proving the results are

statistically similar in a renewed application of the measurement instrument to the same

text.

Reproducibility

The appropriate test to establish reproducibility is inter-coder reliability. To

perform this test one article was selected to be analyzed by all the coders. For each issue

the total number of agreements between the primary researcher and the coder was added

up. This sum was then divided by 24, the total number of coders. This procedure was

repeated for the remaining issues included in the full study. The average percent

agreements for all 35 issues were inputted into JMP$^{©}$ version 5.1 to produce the

histogram and statistical measurements presented in Figure 18 and Figure 19 below.
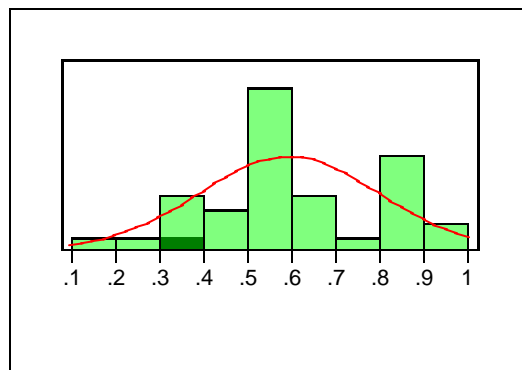
Figure 18. Full Study Average Issue Agreement

```
Mean                0.5940476
Std Dev             0.2032072
Std Err Mean        0.0343483
upper 95% Mean      0.6638517
lower 95% Mean      0.5242435
N                          35
```

Figure 19. Full Study Average Issue Agreement Statistical Measurements

As shown in Figure 19 above, the mean for the coders' average percent agreement for all the issues is 59.40%. The distribution appeared to be normally distributed and the Shapiro-Wilk test supported this claim. The Shapiro-Wilk test evaluated the following two hypotheses at a significance level of 0.05:

H_o: The distribution is normally distributed

H_a: The distribution is not normally distributed

The reported p-value was 0.1450, causing the primary researcher to fail to reject the null hypothesis, supporting the claim the histogram was normally distributed. Therefore, the confidence interval can be used to infer that 95% of the time the coders will have an average percent agreement across all the issues of 66.39% to 52.42%.

The distribution was further analyzed to identify problematic issues. Twelve issues were identified below the confidence interval's lower bound. Therefore, the reliability of these issues could not be supported causing the primary researcher to remove these issues from the measurement instrument. This brought the total number of issues down from 35 to 23 issues. Figure 20 and Figure 21, located below, present the updated histogram and statistical measurements excluding the 12 problematic issues.
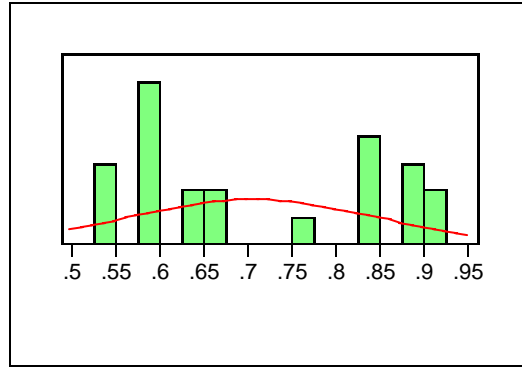
Figure 20. Full Study Problematic Issues Removed

Mean	0.7065217
Std Dev	0.1396007
Std Err Mean	0.0291088
upper 95% Mean	0.7668896
lower 95% Mean	0.6461539
N	23

Figure 21. Full Study Problematic Issues Removed Statistical Measurements

As shown in Figure 21 above, the mean for the coders' average percent agreement for the remaining issues increased from 59.40% to 70.65%. The distribution does not appear to be normally distributed and the Shapiro-Wilk test supported this claim. The Shapiro-Wilk test evaluated the following two hypotheses at a significance level of 0.05:

H_o: The distribution is normally distributed

H_a: The distribution is not normally distributed

The reported p-value was 0.0022, causing the primary researcher to reject the null hypothesis, supporting the claim the histogram was not normally distributed. Therefore, the confidence interval could not be used to make inferences about the coders' average percent agreement for the remaining issues. However, the issues were almost evenly distributed below and above the mean with 13 issues below and 10 issues above the mean.

To declare a percent agreement reliable there must be at least 70% agreement (Frey, Botan et al., 2000). For the 10 issues located above the mean the reliability coefficient range was between 91.67% and 75.00%. Furthermore, the coding schema was created through latent identification of the key issues causing reliability coefficients to be expected to receive lower reliability scores (Neuendorf, 2002). Therefore, the remaining 13 issues' reliability coefficients were accepted as reliable and the issues were retained in the measurement instrument.

With both the reproducibility and stability of the instrument established the internal validity of the instrument was confirmed. The validated coding schema was then utilized to answer the final three investigative questions.

Overview of Findings

This content analysis initially documented 35 latent issues across the 52 articles identified during the sampling procedure. One article was selected to be reviewed by all the coders to provide a measurement of inter-rater reliability. From this assessment 12 issues were identified as unreliable. The remaining issues answer the third investigative question of this research:

3. What does the literature identify as the issues that must be addressed to effectively manage an enterprise architecture?

The 23 issues are presented in Table 5. The respective reliability coefficients are also reported to ensure low reliabilities were not obscured. The top ten issues are reported as highly reliable. The remaining 13 issues must also be addressed, but as can be seen their respective reliability rating is below 70%. Such a low reliability rating

causes the assessment to become difficult to interpret (Neuendorf, 2002). Nevertheless, this research was exploratory in nature making it difficult to maintain objectivity during the process of issue identification. Therefore, these issues are still reported.

Table 5. Reliability Coefficient for Each Issue

Issue	Reliability Coefficient
Understanding the business processes allows the architecture to ensure the implementation of IT systems that will match the required business needs	0.9167
The enterprise architecture must have senior management support	0.9167
Architecture must be capable of adapting or modifying itself to reflect changes in strategic objectives, reorganization and/or business process changes	0.8750
Identify gaps between baseline and established targets	0.8750
Gain knowledgeable architecture resources from consultants	0.8750
Evolve the architecture over time in a iterative step by step transition plan and analyze how changes in the organization's mission, functions, and needs might have an effect on system development	0.8333
The value added from the architecture must be measured by metrics that are clear, meaningful, and quantifiable	0.8333
Standardizing data definitions and data exchange procedures facilitates data integration and data sharing across diverse applications	0.8333
A culture must be developed that focuses on the importance of coordinated planning between business and IT	0.8333
Architecture development must be flexible to accommodate a range of architectures and functional areas	0.7500
Architecture must be tied directly to the organization's operational mission and vision	0.6667
Managing by processes allows architecture modules to become repeatable, reusable, measurable, and reduces	0.6667
Feedback is received on performance so future architecture changes will be more successful	0.6250
Central control of standardized processes allows for rapid innovation from individual business units--best practice processes can be recognized and implemented across the entire organization	0.6250
Framework guides architecture design and investment decision making	0.5833
Start with doable and critical system development projects	0.5833
Common understanding and conformance to architecture principles and standards leads to consistent enforcement of guidance, informed system development decisions, and reduced redundancy	0.5833
Data owners must be identified who are responsible for ensuring the integrity of the data that is provided	0.5833
Development of an architecture must include the business/functional users	0.5833
Select and train a team of enterprise architects, governing bodies and functional users with the ability and authority to answer human, technical, and business questions and carry out assigned responsibilities	0.5833
Define the target business view	0.5417
Determine target architecture (Where we want to be)	0.5417
An architecture is a tool that allows the organization to gain a competitive by being a tool that can assist in making the decision whether or not to implement new technologies and/or retain legacy systems	0.5417

The fourth investigative question was then answered by using the primary researcher's validated codebook. A tally was added for each issue to find out how many times each issue appears across all 52 articles. Table 6 presents the findings that answer the following question:

4. Which issues have the most relevance?

Table 6. Issue Relevance

Issue	Count
Architecture must be tied directly to the organization's operational mission and vision	33
Architecture must be capable of adapting or modifying itself to reflect changes in strategic objectives, reorganization and/or business process changes	27
Evolve the architecture over time in a iterative step by step transition plan and analyze how changes in the organization's mission, functions, and needs might effect system development	27
The enterprise architecture must have senior management support	27
Development of an architecture must include the business/functional users	26
Understanding the business processes allows the architecture to ensure the implementation of IT systems that will match the required business needs	20
Standardizing data definitions and data exchange procedures facilitates data integration and data sharing across diverse applications	19
Determine target architecture (Where we want to be)	16
Select and train a team of enterprise architects, governing bodies and functional users with ability and authority to answer human, technical, and business questions and carry out assigned tasks	15
Framework guides architecture design and investment decision making	14
Common understanding and conformance to architecture principles and standards leads to enforcement of guidance, informed system development decisions, and reduced redundancy	14
Define the target business view	13
An architecture allows the organization to gain a competitive by being a tool that can assist in making the decision whether or not to implement new technologies and/or retain legacy systems	13
Managing by processes allows architecture modules to become repeatable, reusable, measurable, and reduces redundancy	11
Identify gaps between baseline and established targets	9
The value added from the architecture must be measured by metrics that are clear, meaningful, and quantifiable	9
Gain knowledgeable architecture resources from consultants	8
Architecture development must be flexible to accommodate a range of architectures and functional areas requirements	7
Start with doable and critical system development projects	7
Feedback is received on performance so future architecture changes will be more successful	7
The culture must focus on importance of coordinated planning between business and IT	6
Central control of standardized processes allows for rapid innovation from individual business units--best practice processes can be recognized and implemented across the entire organization	4
Data owners must be identified who are responsible for ensuring the integrity of the provided data	4

The category each issue belonged to on the codebook used during the content analysis was introduced to answer the fifth investigative question:

5. What does the literature identify as the underlying factors driving these issues?

Table 7 answers this question by reporting the respective category of each issue.

Table 7. Underlying Factors

Factor	Issue
Operational	Architecture must be tied directly to the organization's operational mission and vision
Flexibility	Architecture must be capable of adapting or modifying itself to reflect changes in strategic objectives, reorganization and/or business process changes
Maintenance	Evolve the architecture over time in a iterative transition plan and analyze how changes in the organization's mission, functions, and needs might effect system development
Organizational	The enterprise architecture must have senior management support
Organizational	Development of an architecture must include the business/functional users
Processes	Understanding the business processes allows the architecture to ensure the implementation of IT systems that will match the required business needs
Data	Standardizing data definitions and data exchange procedures facilitates data integration and data sharing across diverse applications
Development	Determine target architecture (Where we want to be)
Organizational	Select and train a team of enterprise architects, governing bodies and functional users with the ability and authority to answer human, technical, and business questions and carry out assigned responsibilities
Development	Framework guides architecture design and investment decision making
Maintenance	Common understanding and conformance to architecture principles leads to guidance enforcement, informed system development decisions, and reduced redundancy
Development	Define the target business view
Technology	An architecture allows the organization to gain a competitive by assisting in making the decision whether or not to implement new technologies and/or retain legacy systems
Processes	Managing by processes allows architecture modules to become repeatable, reusable, measurable, and reduces redundancy
Development	Identify gaps between baseline and established targets
Maintenance	The value added from the architecture must be measured by metrics that are clear, meaningful, and quantifiable
Organizational	Gain knowledgeable architecture resources from consultants
Flexibility	Architecture development must be flexible to accommodate a range of architectures and functional areas requirements
Maintenance	Feedback is received on performance to make future architecture changes successful
Development	Start with doable and critical system development projects
Organizational	A culture must be developed that focuses on the importance of coordinated planning between business and IT
Processes	Central control of standardized processes allows for rapid innovation from business units--best practice processes are recognized and implemented across the organization
Data	Data owners must be identified who are responsible for ensuring the integrity of the data

The tables presented in this section provide a snapshot of the content analysis and are used to answer the three remaining investigative questions. To reach an

understanding of which issues the Air Force must address to effectively manage its enterprise architecture a more in-depth analysis must be attempted. The next section makes this attempt in an effort to reach the goal of this study.

Discussion

To implement and manage the Air Force Enterprise Architecture the Air Force Communications Agency (AFCA) transitioned their SCOPE Network teams that focused on optimizing and securing the base networks to SCOPE EDGE teams. SCOPE Net's mission was to optimize existing base networks. Today, SCOPE EDGE changed their view of the Air Force network from a collection of individual bases to a network enterprise (Hoeft, 2004).

This research synthesizes the literary efforts of both academic and professional authors to provide AFCA's SCOPE EDGE mission with a strategic guidepost that identifies and analyzes the key issues affecting the Air Force's ability to manage its enterprise architecture. The previous section identified the key issues, but as Table 5 shows there is no consistency in the factors which cause these issues to be relevant. For example, the five most relevant issues are driven by four clearly distinct factors. Even when the top ten most relevant issues are reviewed seven different underlying factors are identified as the reason for their relative importance. Therefore, the conclusion reached from this research is that to effectively manage an enterprise architecture the Air Force must not focus on one organizational factor. Instead, to effectively manage the enterprise architecture a holistic approach must be taken.

From the analysis, two interesting findings are worth mentioning. The first is that of the top ten most relevant issues three of them are driven by organizational factors. The researcher is hesitant to identify this as a clear answer to the goal of this research. However, it can be stated that the effective management of the enterprise architecture requires the dedicated support of the entire organization. The other finding was that technology was only found as the underlying factor for one of the issues. Therefore, it can be said that approaching the management of the enterprise architecture from a technological standpoint may lead to failure.

Applying these findings to AFCA's responsibility to manage the Air Force's Enterprise Architecture reveals a gap between the current enterprise management techniques and the researcher's findings. These findings suggest SCOPE EDGE should consider expanding its technological perspective towards a holistic management approach to accomplish the new mission of strategic network advocacy and enterprise level assessment. The remainder of this section discusses the key issues and their underlying factors as identified by the researcher. This analysis of the findings provides AFCA with a guidepost for their efforts to manage the Air Force's Enterprise Architecture.

As stated above, there was no clear and concise answer to how an enterprise architecture should be managed. For this reason, the primary researcher identified common themes across the identified issues. This allowed the researcher to consolidate the findings into a manageable set of issues and then discuss the possible implications. The first issue is the only one that stands out above the other issues. It was acknowledged in over 67% of the article analyzed. This issue states the enterprise

architecture must be tied directly to the organization's operational mission and vision.

Furthermore, four other issues appeared in over 50% of all the articles analyzed. Table 8 reports the top five issues identified by the primary researcher. As can be seen, these five issues have an underlying theme appearing in each one. In short, each issue has a direct impact on the organization's operational mission and vision.

Table 8. Top Five most Relevant Issues

Architecture must be tied directly to the organization's operational mission and vision	33
Architecture must be capable of adapting or modifying itself to reflect changes in strategic objectives, reorganization and/or business process changes	27
Evolve the architecture over time in a iterative step by step transition plan and analyze how changes in the organization's mission, functions, and needs might have an effect on system development	27
The enterprise architecture must have senior management support	27
Development of an architecture must include the business/functional users	26

The number of times these five issues appeared as compared to the remaining 18 issues expounds upon the importance of tying the enterprise architecture directly to the mission and vision. Overall, the 35 issues included in the coding schema resulted in a total of 304 issues being identified throughout the 52 articles. These five issues account for over 46% of this cumulative total. It must be noted the first three issues all directly make reference to how the enterprise architecture must be connected to the mission. The remaining two issues do not make this direct connection. In spite of this, it is not difficult to understand that the senior manager sets the mission and vision while the business and functional users ensure the mission is accomplished. In the end, the importance of tying the enterprise architecture to the organization is stressed throughout the analyzed literature.

Individually analyzing the next nine issues causes them to appear to be unrelated. As the issues are bridged together, the common theme of controlling the enterprise

architecture emerges. Just as an enterprise architecture has several views that must be integrated together, controlling an enterprise architecture must be approached from several angles. Six different views of control were documented during the content analysis. The views and their related issues are put forward in Table 9. These nine issues must be addressed to ensure the enterprise architecture is properly controlled.

Table 9. Control Issues

Data	Standardizing data definitions and data exchange procedures facilitates data integration and data sharing across diverse applications
Development	1. Framework guides architecture design and investment decision making
	2. Determine target architecture (Where we want to be)
	3. Define the target business view
Maintenance	Common understanding and conformance to architecture principles leads to consistent guidance enforcement, informed system development decisions, and reduced redundancy
Organizational	Select and train a team of enterprise architects, governing bodies and functional users with the ability and authority to answer human, technical, and business questions and carry out assigned responsibilities
Processes	1. Understanding the business processes allows the architecture to ensure the implementation of IT systems that will match the required business needs
	2. Managing by processes allows architecture modules to become repeatable, reusable, measurable, and reduces redundancy
Technology	An architecture is a tool that allows the organization to gain a competitive by being a tool that can assist in making the decision whether or not to implement new technologies and/or retain legacy systems

The ability to exploit an enterprise architecture to direct, measure, and capture change accounts for just over 15% of total number of issues identified in all the articles. This theme is seen in the next six issues which are presented in the following table:

Table 10. Direct, Manage, and Capture Change Issues

Identify gaps between baseline and established targets
The value added from the architecture must be measured by metrics that are clear, meaningful, and quantifiable
Gain knowledgeable architecture resources from consultants
Architecture development must be flexible to accommodate a range of architectures and functional areas requirements
Feedback is received on performance so future architecture changes will be more successful
Start with doable and critical system development projects

The low frequency score of these issues demonstrates the lack of attention placed on them. This adds support to the motivation for completing this research. The development and implementation of enterprise architectures has been discussed across a wide variety of literature. Conversely, the topic of managing an enterprise architecture has not been adequately addressed. Each of these issues covers a different aspect of managing an enterprise architecture. As can be seen, additional emphasis must be placed on properly managing an enterprise architecture.

The final three issues are presented below in Table 11. These issues all are concerned with centralized coordination of the enterprise architecture.

Table 11. Central Coordination Issues

A culture must be developed that focuses on the importance of coordinated planning between business and IT
Central control of standardized processes allows for rapid innovation from individual business units--best practice processes can be recognized and implemented across the entire organization
Data owners must be identified who are responsible for ensuring the integrity of the data that is provided

Once again these three issues received the least amount of attention throughout the articles selected for the content analysis. This finding can also be attested to the fact that there is a void in the body of knowledge concerning the management of an enterprise architecture.

The 23 issues were reviewed causing four themes to be identified: (1) tying the enterprise architecture to the operational mission, (2) controlling the enterprise architecture, (3) directing, measuring, and capturing change, and (4) centralized coordination. These four themes provide AFCA with the necessary foundation required to begin to effectively manage the Air Force Enterprise Architecture. In addition, the

issues underlying each theme offer enterprise architecture practitioners with a means to develop relevant operational measurements to determine how mature the enterprise architecture is in relation to set standards.

Limitations of Results

During the computation and analysis of the results four additional limiting factors were identified. These factors include potential confounding factors affecting the stability measurement, the normality of the distributions, the low reproducibility measurement, and the inability to generalize about the findings. This section discusses each of these limiting factors.

The independent t-test proved the coding schema was stable across two groups measuring identical articles. This test requires the samples to be independently and randomly selected from the population. In this study the two groups were not selected in this manner. Instead the groups were chosen by stratifying the population of coders by operational and educational experience. Another potential confounding factors is that all the coders were enrolled in an Enterprise Architecture course while the study was conducted. These two confounders factors may have affected the results of the test for stability.

To establish the internal validity and reliability of the coding schema the frequency distribution of each percent agreement measurement was analyzed. As reported in the pilot and full study, the assumption of normality could not be supported for each distribution. To overcome this limitation the sample size would have to be increased to allow the measurements to approach a normal distribution.

Another limiting factor was the original coding schema's low percent agreement for the inter-rater reliability measurement. Once the unreliable issues were removed from the schema the mean increased from 59.40% to 70.65%. This demonstrates improvements could have been made by clarifying terms used in the coding schema. This would decrease the variability caused by the subjective judgment of the coders and allowed for an effective analysis of the articles included in the study.

The data collection process used was nonrandom, limiting the ability to make generalizations of the findings to the entire population of enterprise architecture literature. The articles chosen for this study were initially selected from the top ten management journals to remove the researcher's subjective bias during the article selection. In ensuring that bias was removed, the article collection was constrained to only these journals. The imposed constraints caused the sample to become nonrandom.

Furthermore, the identified articles' keywords were then used to perform an online search for data sources. Online searches are plagued by the difficulty to establish a population and a sampling frame (Neuendorf, 2002). Exhaustive searches were performed to include conference proceedings, a variety of peer-review articles, professional papers, and government reports. However, without a defined population a truly random sample could not be selected.

Summary

The results of this research were presented. First, an agreed upon operational definition was presented to answer the first two investigative questions. Once the contextual basis had been established, the descriptive statistics of the sample set was

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reported. Next, the results from the steps taken to validate the coding schema were described. The full study was then conducted. From this study the reliability of the coding schema was established by analyzing the reproducibility and stability of the measurement instrument. With the validity and reliability of the measurement instrument established, it was then utilized to examine the primary researcher's coding results to answer the final three investigative questions of this research. This analysis was then used to discuss the interpretation of the results. Finally, the limitations of the study's results were presented.

V. Conclusion

Closing Remarks

The results of this research has implications not only for AFCA. The Air Force is transitioning from an acquisition system based upon platform specific purchases to a capabilities based force. Ensure an organization's data, information, personnel, and information systems are being utilized to achieve the identified capability requirements can be accomplished by employing an enterprise architecture. The following two sections discuss the implications for the sponsor of this research, AFCA and the possible impact a properly manage enterprise architecture may have on the Air Force.

Implications for AFCA

To comply with Section 5125 of the Clinger-Cohen Act and OMB circular A-130 the Air Force has developed an enterprise architecture to guide its investment in information systems. The responsibility of implementing and managing this enterprise architecture has become the responsibility of the Air Force Communications Agency. In response, AFCA transitioned from SCOPE Network teams that focused on optimizing and securing the base networks to what are called SCOPE EDGE teams. While SCOPE Net's mission was network optimization, SCOPE EDGE has increased the level of responsibility to include strategic network advocacy and enterprise level assessment (Hoeft, 2004).

AFCA's new mission has caused SCOPE EDGE to no longer view each base network individually. Instead, the focus has shifted to ensure compliance with architecture standards for the entire network enterprise. Unfortunately, this focus only

accounts for the technological view of the Air Force's Enterprise Architecture. This focus places an emphasis on the hardware and software that comprises the enterprise architecture, but neglects the other architecture views.

In response to SCOPE EDGE's network-based strategic perspective, this research was conducted to synthesize the literary efforts of both academic and professional authors to provide AFCA's SCOPE EDGE mission with a strategic guidepost that identifies and analyzes the key issues affecting the Air Force's ability to manage its enterprise architecture. Chapter 4's presentation of the findings and discussion achieved the stated objective of this research. However, there was no clear and concise answer to the central research question. Ultimately, the researcher concluded that the effective management of an enterprise architecture requires AFCA to not focus on one factor; instead, a holistic management approach must be taken.

Currently, SCOPE EDGE is measuring the Network Health of the network enterprise through the use of a Network Maturity Model. However, AFCA's responsibility is to provide enterprise level assessment. Since the focus has expanded from the network to the entire enterprise architecture, SCOPE EDGE can no longer afford to focus on just the technology that comprises the enterprise. The research findings show AFCA's strategic perspective should be broadened to manage all aspects of the Air Force's Enterprise Architecture.

To provide the Air Force Communications Agency with a foundation to begin to manage the Air Force's Enterprise Architecture the researcher identified common themes across the identified issues. The 23 issues were reviewed causing four themes to be identified: (1) tie the enterprise architecture to the Air Force's operational mission, (2)

control the enterprise architecture, (3) direct, measure, and capture change, and (4) centralize coordination. From these four themes an enterprise architecture maturity model could be developed to replace the current Network Maturity Model. This would allow SCOPE EDGE to broaden their perspective from focusing on only the technological components of the enterprise to having the ability to effectively manage the entire enterprise architecture.

To develop an enterprise architecture maturity model the issues underlying the identified themes provide AFCA with a means to develop relevant statistical measurements to determine how mature the enterprise architecture is in relation to set standards. In turn, the ability to measure the salient issues when managing the enterprise architecture permits managers to assess progress toward the desired end and to take corrective action to address unacceptable deviations. In the end, SCOPE EDGE will have an assessment tool to determine if the Air Force can effectively manage its enterprise architecture.

Implications for the Air Force

The Air Force's currently defines its enterprise architecture as three inter-related components consisting of a system view, operational view, and technical view. However, these three components do not incorporate the people, data, or motivation views as proposed by Zachman's enterprise architecture framework (Zachman 1987). The absence of these views hinders the Air Force's ability to utilize its enterprise architecture to tie its information systems directly to the operational mission.

As the Air Force transitions to a capabilities based force, the motivation view, which is absent from the Air Force's framework, would allow the architect to determine

how an information system could possibly enable the required capability. Today technological solutions are being developed prior to understanding the underlying motivations for the identified requirement. Instead, the motivation view must first be defined to determine if a technological solution is feasible and/or appropriate. In turn, this would ensure the information systems are directly tied to the operational mission.

In the Air Force of today, there exists an ever widening gap between the information system user and the provider of that same system. The lack of understanding of how the system is employed in the operational environment causes technological decisions to be made that could potentially cause a degradation of the services provided by the system. By expanding the Air Force's current enterprise architecture to include a people view a bridge would be placed across this current gap that exists between the operator and the user.

The Air Force has placed its focus on developing its technical view of its enterprise architecture; however, this view only pertains to the enterprise infrastructure. Equally important is both the business architecture and information architecture views. The Air Force's enterprise architecture does address the business architecture in its operational component, but once again the information architecture has no central coordinating mechanism in place.

As can be seen, efforts must be made by the Air Force to expand its enterprise architecture to integrate all views of the enterprise architecture. This holistic approach not only will confirm it is properly managed, but it will also ensure the information system is directly supporting the organization's operational mission.

Conclusion

This research contributes to both practitioners and academic researchers. As the Air Force continues to implement and manage its enterprise architecture this study provides practicing enterprise architects with a consolidated list of the key issues that should be addressed to manage an enterprise architecture. In addition, it demonstrates that no one factor leads to the successful management of the enterprise. Instead, the architect must focus on all aspects of managing the architecture. At the same time, this research fulfills an academic void. To date the current stream of research has not identified the key issues involved in the successful management of an enterprise architecture or the underlying factors driving these issues. This study laid the groundwork to remove this obstacle.

Limitations of Research

Limiting factors emerged during this research. These limitations were identified in the validity, reliability, and generalizability of the research and are addressed in the following three sections.

Reliability

The measurement instrument's reproducibility was reported by measuring each issue's percent agreement between the primary researcher and the 24 coders. However, Cohen's Kappa is a stronger measurement coefficient because it removes chance agreement (Neuendorf, 2002). Since this research had 35 issues, chance agreement, even though possible, was not seen as a confounding factor. In addition, the original coding schema's low percent agreement was another limiting factor. Once the unreliable issues

were removed from the schema the mean percent agreement increased from 59.40% to 70.65%. Improvements could have been made by clarifying terms used in the coding schema. This would decrease the variability caused by the subjective judgment of the coders and allow for an effective analysis of the articles included in the study.

The coding was performed by 12 groups each consisting of two students. To establish the instruments stability the two students were each assigned the same articles. However, these students were all enrolled in an Enterprise Architecture class during data collection. An independent group of coders was not identified to ensure the educational experience was not a confounding factor on the results obtained. Therefore, even though it was addressed, stability was identified as a limitation to this research effort.

Validity

In this research, both the external and internal validity had shortcomings. The internal validity had to be addressed because each of the issues included in the codebook were not identified before the content analysis. This did not allow the match up of a conceptual definition and an operational measurement (Neuendorf, 2002). To overcome this limitation an impartial process of issue development was used. Four co-researchers were each assigned a subset of the articles included in the content analysis to address the potential for personal bias and to prevent errors of judgment and misinterpretation of the text by the primary researcher.

The external validity is substantiated from the ability of others to repeat the study with a different set of messages (Neuendorf, 2002). Since there were no prior research efforts identifying how an enterprise architecture should be managed, this research

employed an exploratory strategy. Therefore, there are no successful replications to support the external validity.

Generalizability

The data collection process used was nonrandom, limiting the ability to make generalizations of the findings to the entire population of enterprise architecture literature. The articles chosen for this study were initially selected from the top ten information system management journals to remove the researcher's subjective bias during the article selection. In ensuring that bias was removed, the article collection was constrained to only these journals. The imposed constraints caused the sample to become nonrandom. Furthermore, the articles' keywords were used to perform an online search for data sources. Online searches are plagued by the difficulty to establish a population and a sampling frame (Neuendorf, 2002). Without a defined population a truly random sample could not be selected.

Concurrent Thesis Research Efforts

It is important to note that there has been concurrent research performed for AFCA, the sponsor of this research. First Lieutenant Charlie Boyd's focus his efforts on the Air Force's enterprise infrastructure by examining Air Force installation-level networks that contribute to DoD's interoperability and integration. He focused on installation-level wide area and local area networks, WANs and LANs respectively, which represent the lowest Air Force portion of the Global Information Grid. Currently, services cannot support the DoD blueprint for development and transformation without addressing installation-level networks. Therefore, his research study explores Air Force

installation-level or base area network (BAN) architectures. Lt Boyd's thesis was completed over the same time period as this thesis was undertaken and is scheduled to be completed and published in March 2005.

Suggestions for Further Study

Qualitative research can never capture objective reality; therefore, further studies are required to secure an in-depth understanding of the issues the Air Force must address to effectively manage its enterprise architecture. The results of this study establish a foundation that can be used as a stepping stone for a multitude of follow-on studies.

A follow-on study duplicating this methodology, but using a different coding process is recommended. One proposal is to add weights to the presence of an issue within each article. This would separate issues that are mentioned in the article, but not well developed from issues that are the driving reason the article is written. The effect of this coding process would be to address the level of importance of the identified issues across all the articles included in the content analysis. In addition, the follow-on study should identify a different collection of articles by reviewing additional academic journals and using another set of key word searches or utilizing other database search engines. Increasing the sample size and then comparing the results of the new articles to the original set of articles would allow the results to be generalized to the entire population of enterprise architecture literature.

With these results, the question of what are the key issues the Air Force must address would be answered. The next question to answer is how are these key issues being addressed? A multi-site case study focusing on the management practice of

enterprise architects within each Air Force MAJCOM, Direct Reporting Unit, and Field

Operating Agency would expand upon the identified issues. Analyzing these particular

organizations would provide a greater understanding of the issues and their underlying

factors. The ability to find architects who are managing all aspects of the enterprise

architecture may prove to be challenging, but this study would provide the Air Force with

an independent assessment of their current level of architecture maturity.

Finally, each of the identified issues could be used to form an interview and

survey. These measurement instruments could then be used to conduct a Pre-Interview

Survey of Air Force enterprise architects. The survey would identify potential architect

experts and determine how pertinent the identified issues are to practitioners. In addition,

the interview could determine how the identified issues can be or have been

operationalized into measurable statistics. This would provide a means to measure where

on the enterprise architecture capability maturity model an organization is located.

Appendix A: Content Analysis Articles

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Appendix B: Original Codebook

Article Number	
Key Issues	
Flexibility	Architecture development must be flexible to accommodate range of architectures and functional areas requirements
	Architecture must be adaptable/modifiable to allow for reviewing and updating the architecture to reflect changes in strategic business objectives, reorganization or business process changes
	System development must be robust to handle many iterations required to refine processes and to incorporate changes to the system
Development Control	Architecture baseline must be established and organization must have a clear understanding of the business strategies that must be supported by the organization's enterprise architecture (Where we are)
	Framework guides architecture design and investment decision making
	Define the target business view
	Determine target architecture (Where we want to be)
	Identify gaps between baseline and established targets
	Outline plan on how to reach target architecture--develop a modernization/implementation plan (How we are going to get there)
	Use an agreed upon system development methodology and universal standards
	Start with doable and critical system development projects
Operational Control	Architecture must be tied directly to the organization's operational mission and vision
	Business requirements drive the rest of the target architectural views
	Governace of the architecture establishes and communicates a defined structure and clear roles and responsibilities
Maintenance Control	Evolve the architecture over time in a iterative step by step transition plan of continous improvement and analyze how changes in the organization's mission, functions, and needs might have an effect on system development
	Common understanding and conformance to architecture principles and standards leads to consitent enforcement of guidance, informed system development decisions, and reduced redundancy
	The value added from the architecture must be measured by metrics that are clear, meaningful, and quantifiable
	Architecture changes must be centrally controlled and changes must be directed through the group responsible for this task
	Feedback is recieved on performance so future architecture changes will be more successful
	Focus must be maintained on business and technology risk mitigation
Processes	Understanding the business processes allows the architecture to align and/or modify the IT goals and objectives to ensure the implementation of IT systems that will match the required business needs
	Organization's must make the transition from function oriented management to process based management
	Managing by processes allows architecture modules to become repeatable, reusable, measurable, and reduces redundancy
	Central control of standardized processes allows for rapid innovation from individual buinsess units--best practice processes can be recognized and implemented across the entire organization
Openness	Architecture provides common and centralized standards leading to an open system where system components can be reused
	An interoperable architecture allows other systems to easily integrate into it--systems can be moved in and out of the architecture
	Avoid intrusive integration by modifying code in legacy systems--use data brokers to transform data from one format to another
Data	Standardizing data definitions and data exchange procedures facilitates data intergration and data sharing across diverse applications
	Data owners must be identified who are responsible for ensuring the integrity of the data that is provided
Technology	As new computing models become available an architecture is used to make decisions in deciding to implement new technologies and/or retain legacy systems to develop the best technological fit for the organization so it can gain a competitive advantage
	A developed IT infrastructure that enforces its standards gives an organization the ability to manuever in response to market opportunities
Organizational / Personnel	The enterprise architecture must have senior management support
	Development of an architecture must include the business/functional users
	Gain knowledgeable architecture resources from consultants
	Select and train a team of enterprise architects, governing bodies and functional users with the ability and authority to answer human, technical, and business questions and carry out assigned responsbilities
	A culture must be developed that focuses on the importance of coordinated planning between business and IT

Appendix C: Validated Codebook

Article Number	
Key Issues	
Flexibility	Architecture development must be flexible to accommodate a range of architectures and functional areas requirements
	Architecture must be capable of adapting or modifying itself to reflect changes in strategic objectives, reorganization and/or business process changes
	System development must be robust to handle the multiple iterations required to refine processes and incorporate changes to the system
Development Control	Architecture baseline must be established and the organization must have a clear understanding of its business strategies (Where we are)
	Framework guides architecture design and investment decision making
	Define the target business view
	Determine target architecture (Where we want to be)
	Identify gaps between baseline and established targets
	Outline plan on how to reach target architecture--develop a modernization/implementation plan (How are we going to get there)
	Use an agreed upon system development methodology and universal standards
	Start with doable and critical system development projects
Operational Control	Architecture must be tied directly to the organization's operational mission and vision
	Business requirements drive the rest of the target architectural views
	Governance of the architecture communicates a defined structure and establishes clear roles and responsibilities
Maintenance Control	Evolve the architecture over time in a iterative step by step transition plan and analyze how changes in the organization's mission, functions, and needs might have an effect on system development
	Common understanding and conformance to architecture principles and standards leads to consistent enforcement of guidance, informed system development decisions, and reduced redundancy
	The value added from the architecture must be measured by metrics that are clear, meaningful, and quantifiable
	Architecture changes must be centrally controlled and changes must be directed through the group responsible for this task
	Feedback is received on performance so future architecture changes will be more successful
	Focus must be maintained on business and technology risk mitigation
Processes	Understanding the business processes allows the architecture to ensure the implementation of IT systems that will match the required business needs
	Organization's must make the transition from function (stove-piped) oriented management to process (horizontal) based management
	Managing by processes allows architecture modules to become repeatable, reusable, measurable, and reduces redundancy
	Central control of standardized processes allows for rapid innovation from individual business units--best practice processes can be recognized and implemented across the entire organization
Openness	Architecture provides common and centralized standards leading to an open system where system components can be reused
	An interoperable architecture allows other systems to seamlessly integrate with it, allowing other systems to be moved in and out of the architecture
Data	Standardizing data definitions and data exchange procedures facilitates data integration and data sharing across diverse applications
	Data owners must be identified who are responsible for ensuring the integrity of the data that is provided
Technology	An architecture is a tool that allows the organization to gain a competitive by being a tool that can assist in making the decision whether or not to implement new technologies and/or retain legacy systems
	A developed IT infrastructure that enforces its standards gives an organization the ability to maneuver in response to market opportunities
Organizational / Personnel	The enterprise architecture must have senior management support
	Development of an architecture must include the business/functional users
	Gain knowledgeable architecture resources from consultants
	Select and train a team of enterprise architects, governing bodies and functional users with the ability and authority to answer human, technical, and business questions and carry out assigned responsibilities
	A culture must be developed that focuses on the importance of coordinated planning between business and IT

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Vita

First Lieutenant Jamie P. Sharkey graduated from Brookville High School in Lynchburg, Virginia in June 1992. Six months later he enlisted in the Air Force. While serving as an enlisted member Lt Sharkey persued his Bachelor of Science degree in Information Systems Management for the University of Maryland University College. Upon completion of his degree in May 2000 he was commissioned through Officer Training School where he graduated as a Distinguished Graduate in November 2000.

His first assignment as an officer was at Langley AFB, VA. There he served as a crew commander for Global Command and Control Systems and Theater Battle Management Core Systems from December 2000 until July 2003. In August 2003, he entered the Graduate School of Engineering and Management, Air Force Institute of Technology. Upon graduation he will be assigned to the Air Intelligence Agency at Lackland AFB, TX.

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14. ABSTRACT
   The Air Force is developing and implementing an enterprise architecture to meet the Clinger-Cohen Act's requirement that all federal agencies use an architecture to guide their IT investments. However, this act does not provide guidance on how to effectively manage an enterprise architecture. Prior research applied maturity models and competency stages to manage an enterprise architecture by defining layers of enterprise architecture management maturity. However, these efforts tend to view enterprise architecture development as a one-time planning process rather than an iterative progression. Enterprise architecture is not a one-time exercise, but rather it is an on-going effort within the organization to rationalize, integrate, and optimize the IT capability within an organization across many projects and business units. Hence, the critical success factors to effectively manage an enterprise architecture must be identified to ensure the structure, processes, and governing mechanisms are established within the organization for maintaining an enterprise architecture. This research draws from existing academic, professional, and government literature to identify the key issues affecting the Air Force's ability to manage its enterprise architecture effectively. Once identified, a quantitative analysis will assist in interpreting the qualitative findings in hopes of determining the underlying factors driving these issues.

15. SUBJECT TERMS
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