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Investigation of Geobase Implementation Issues: Case Study of Information Resource Management

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INVESTIGATION OF GEOBASE IMPLEMENTATION ISSUES:

CASE STUDY OF INFORMATION RESOURCE MANAGEMENT

THESIS

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ABSTRACT

US companies spent more than $250 billion each year in the 1990s on information system and technology (IS&T) projects. Furthermore, the US government expends approximately $25 billion annually on IS&T purchases. However, the overall success rate of IT projects is below 20 percent. In 2001, over 500,000 IT projects were initiated. Increasing the success rate of IS&T projects equates to billions of dollars in savings.

The 1990s also experienced a diffusion of geographic information systems (GIS). Specifically, many military installations adopted GIS technology. Rapid technological developments created a gap between potential benefits of GIS and the frustrations realized due to an inability to assimilate GIS into business processes. The lack of a coherent service-wide insertion process led to the failure of all DoD-sponsored GIS.

GeoBase represents the most recent attempt to exploit GIS by the Air Force. The GeoBase program focuses on information resource management (IRM) and cultural issues. The GeoBase Sustainment Model (GSM), anecdotally developed by GeoBase leadership to reflect implementation issues and the IRM practices of the program, presents a prime research opportunity to examine the legitimacy of the initiative.

The researcher conducted a case study investigation of GeoBase implementation issues. Reported implementation issues reflected predictions based on literature. Using content analysis, the researcher qualitatively assessed the GSM with respect to both reported issues and key IRM dimensions as defined by this research. The GSM proved representative of both the reported issues and key IRM dimensions. However, the absence of communication issues and advisory committees in the model indicates underspecification. Minor changes would drastically improve the model.

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INVESTIGATION OF GEOBASE IMPLEMENTATION ISSUES: CASE STUDY OF INFORMATION RESOURCE MANAGEMENT

Chapter I. Introduction

The United States (US) government expends approximately $25 billion annually on information technology (IT) purchases (Cook, 1996). In the 1990s, US companies spent more than $250 billion each year on about 175,000 IT and information system (IS) projects (The Standish Group, 1994). The overall success rate of these IT projects was only 16.2 percent with more than 31 percent cancelled before completion, costing more than $81 billion per year (Crescenzi, 1988; The Standish Group, 1994). In 2001, over 500,000 IT projects were initiated (Schwalbe, 2004). Increasing the success rate of IT and IS projects equates to billions of dollars in cost avoidance (The Standish Group, 1998).

The 1980s and 1990s also experienced a rapid diffusion of geographic or geospatial information system (GIS) technology (Foresman, 1998; *Improving Management of Information and Technology*, 2001). Specifically, many military installations adopted GIS technology (Cullis, 2000b). The pace of technological developments has, unfortunately, "been much faster than society's ability to assimilate the technology into their routine use" (Cullis, 1995, p. 4). Therefore, a "growing chasm between potential GIS benefits and the realized frustrations" continues to develop (Cullis, 1995, p. 4). "Lacking a coherent service-wide insertion process, **none** of the several initiatives that have been sponsored over the years can be considered a qualified success" (Cullis, 2000a, p. 23).

GeoBase represents the most recent attempt to exploit geospatial technologies by the US Air Force (USAF) across functional communities. Centered on a GIS as the technical solution, the GeoBase initiative remains subject to the same challenges encountered by all IS. GeoBase leadership has implemented a "radically different approach to the geospatial IT insertion dilemma" (Cullis, 2000a). The insertion effort focuses on cultural and information resource management (IRM) issues (Cullis, 2002b; Zettler, 2002).

IRM represents an overarching construct, facilitating examination of issues across functional communities. Currently, the USAF IRM structure includes a chief information officer (AF-CIO) position at the Headquarters USAF (HAF). The AF-CIO adheres to the principles outlined in the Information Technology Management Reform Act of 1996 (also known as the Clinger-Cohen Act (CCA)), which established departmental CIOs and provided new guidance for IT acquisition and IRM. Recently, the Joint Chiefs of Staff announced the principles for IT management and acquisition outlined in the CCA will now be applied to all military IS, including warfighting systems (Miller, 2003). The statement emphasizes the need for sound IRM.

The exorbitant amount of money spent on failing IT projects, including IS, make research aimed at increasing the success of such projects a worthy endeavor. Furthermore, government IT projects have been under increased pressure to comply with Federal mandates concerning IRM. GeoBase, therefore, provides a near perfect lens for researching IS implementation and potential IRM issues. The GeoBase Sustainment Model (GSM), developed by GeoBase leadership to reflect implementation issues and the IRM practices of the program, presents a prime research opportunity to examine the legitimacy of the initiative.

Purpose

The researcher will conduct a case study investigation of GeoBase implementation issues as perceived at the USAF-major-command (MAJCOM) level in order to qualitatively assess the validity of the anecdotally constructed GSM. In addition, the researcher proposes to assess the model against key information resource management (IRM) dimensions and assess GeoBase's adherence to the same. The researcher will execute a content analysis of IRM and the GSM. A comparison of the two content analysis sets will be used to qualitatively validate GSM as an IRM model, demonstrating legitimacy in USAF-IRM arenas.

Research Questions

The HAF-Geo Integration Officer (HAF-GIO) purports the current GSM represents GeoBase implementation issues and both Federal and academic IRM as defined by literature and documents from Federal and academic sources. The following research questions must be answered in the attempt to qualitatively assess this assertion:

1. What are the current key GeoBase implementation issues as reported by MAJCOM GIOs?

2. How do these reported issues compare to the implementation issues represented by the HAF-GIO in the GSM?
3. What are the key dimensions of the IRM construct as it applies to this research?
4. How does the current GSM compare to the key dimensions of the IRM construct?
5. How does the GeoBase Program, as represented by the GSM and as currently implemented, address key dimensions of IRM as specified by the Federal Government?
6. What changes, if any, are required to update the current GSM?

Significance

This research examines the GSM which has not previously been validated. By qualitatively validating the anecdotally developed elements of the GSM, a greater degree of legitimacy can be shown. Validation will be performed by identifying previously unexplored GeoBase implementation issues. The researcher will also provide visibility of the reported issues to the civil engineer (CE) and communications and information (C&I) communities for the first time. In addition, the researcher intends to define a more complete list detailing IRM practices relevant to GeoBase and the USAF environment. Furthermore, the researcher will relate the IRM practices to those specified by the Federal government and literature. Highlighting the key IRM dimensions practiced by the GeoBase community as indicated in the GSM demonstrates adherence to CIO policy and further legitimizes the GeoBase program as a low-risk investment during a time when IT expenditures are rampant.

Thesis Overview

This thesis contains five chapters. In the current chapter, the introduction was presented. The purpose, research questions, and significance of this research was offered. In the next chapter, the literature review will be developed. The topics necessary to understand the research leading up to this effort are included. IRM definitions, IS and GIS implementation issues, and the GSM indicate some of the areas covered. Next, the third chapter presents the methodology. The chapter describes how the case study and content analysis were employed for data collection and analysis. Then, the results will be explored in the fourth chapter. The presentation of the results uses the research questions as an outline. Finally, chapter five details a discussion of the results. Implications of the results, possible limitations, and ideas for future research are also contained in the chapter. References and appendices follow the final chapter.

Chapter II. Literature Review

An investigation of GeoBase implementation issues through an IRM lens requires several topics to be understood. First, the IRM construct must be explored. A comprehensive, working definition must be determined. In order to properly discuss GeoBase implementation issues, IS implementation must also be reviewed. This will develop an understanding of the broad range of possible implementation issues expected. A brief examination of the development and capabilities of geographic information systems (GIS) will next introduce GeoBase, a GIS-based program. Then, an investigation of GIS implementation issues will refine the study to the necessary scope. The last step entails an exploration of known GeoBase-specific implementation issues and the documented role of IRM within GeoBase.

The Information Resource Management Construct

A functional or operational definition of IRM must be determined in order to execute the proposed research. However, a single definition of the IRM construct has not been universally accepted by either the business or academic arenas. The following section describes the development of IRM definitions in the literature and the federal government, including and primarily the US Department of Defense (DoD) and the USAF. The section closes with the rationale for choosing the method of operationalizing the IRM construct for this study.

Information Resource Management Academically Defined

The literature abounds with many definitions of IRM. As Lewis, Snyder, and Rainer (1995) point out, several of these definitions attempt to expound upon the constituent parts of IRM (information, resource, and management). Owen (1989), for instance, extensively discusses the elements of IRM without positing a new, comprehensive, and non-recursive definition (his model of IRM is presented later in the chapter). Such definitions lack the specificity and completeness required to evaluate the research question.

Composite IRM definitions derived through literature reviews.

Lytle (1988) and Trauth (1989), for example, provide their analysis of the IRM literature by presenting the IRM construct as comprised of distinct dimensions. Although their extensive literature reviews, spanning 15 years of publications in all, produced more complete views of the IRM construct, each emphasizes particular phenomena. Lytle focuses on the convergence of communications, office automation, and data processing technologies. In addition, he cites the importance of information and information technology in strategic planning. Lytle does not posit his own formal definition of the "eclectic nature of IRM" (1988, p. 10), relying instead on the application of the discipline to define itself. However, Trauth emphasizes the development of IRM primarily from the database, records, and data processing disciplines through the advancement of computer and communications technologies. Trauth particularly highlights the advent of knowledge work as a concept driving IRM development. For a representative IRM definition, Trauth cites the broad characterization of Wood (1983, p. 12), who categorizes information as an important organizational resource and IRM as a perspective to managing the information:

> IRM is a synthesis of several approaches that have been demonstrated to be useful in managing information. It combines general management (resource handling), computer systems management, library science and policy making and planning approaches. It is the next step in the evolution of information management thought and not a panacea or a fully developed approach.

Lytle and Trauth, though more complete in their definitions, still fail to present a comprehensive, specific, and unified definition of IRM.

Multidimensional IRM definitions.

Lewis, Snyder, and Rainer (1995, p. 202) state, "IRM model development has contributed to the difficulties in achieving a common framework for the conduct of research on the IRM construct". For example, Owen (1989) and O'Brien and Morgan (1991) present divergent IRM models (see Figure 1 and Figure 2). Each author focuses on particular aspects of the construct while attempting to capture the greater whole. From a holistic perspective, the models are too far removed from the details to develop an operational IRM construct. Owen (1989) presents a hierarchal model, detailing an IT-centric view (Figure 1). In Owen's model, IT creates the base which supports IS (automated and otherwise) with information itself atop. O'Brien and Morgan (1991) relate an IRM model comprised of resource, technology, functional, strategic, and distributed management aspects (Figure 2). While the models are not specific enough to use operationally, these models do underscore the multidimensional nature of IRM. Lewis et al.'s research offers a more fully prescribed multidimensional perspective (1995).

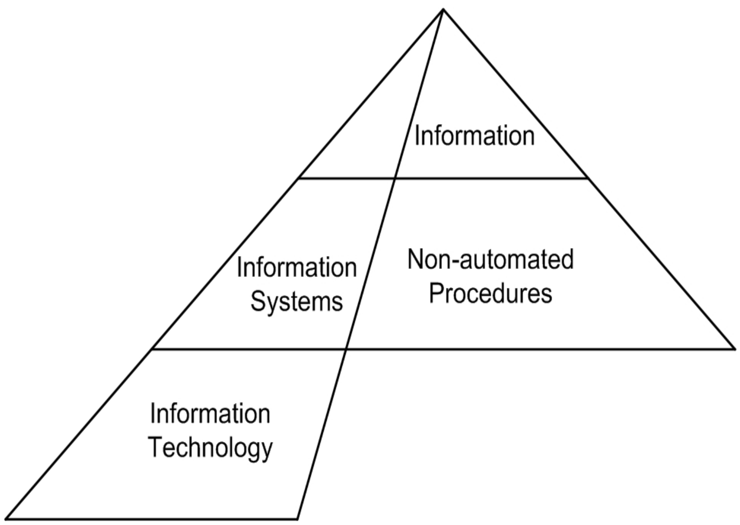

Figure 1. Expanded Information Resource Management (Owen, 1989)

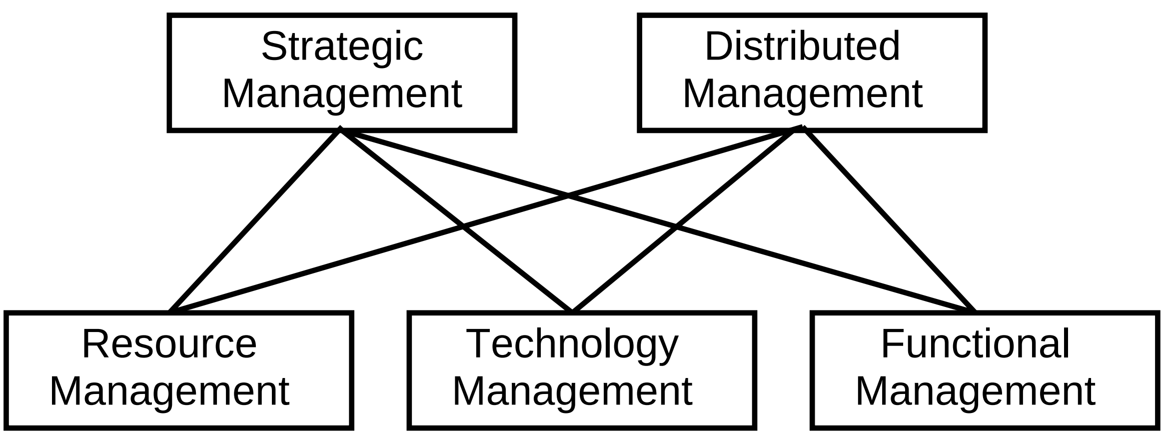

Figure 2. Multidimensional Model of IRM (O'Brien & Morgan, 1991)

Lewis, Snyder, and Rainer IRM definition.

Lewis, Snyder, and Rainer (1995) also performed a massive content analysis of the IRM literature. Following their review, Lewis et al. "synthesized the following inclusive definition":

> IRM is a comprehensive approach to planning, organizing, budgeting, directing, monitoring and controlling the people, funding, technologies and activities associated with acquiring, storing, processing and distributing data to meet a business need for the benefit of the entire enterprise (1995, p. 204).

Similar to the previously cited composite and multidimensional model approaches to defining IRM, Lewis, et al. capture the breadth of the IRM construct in their definition. They also created a more precise and specific definition. However, Lewis, et al. recognized that "[m]ost articles on the topic of IRM are based on either opinion or anecdote" (1995, p. 202). As such, they went on to operationalize and test the IRM construct. Developing an instrument and using exploratory factor analysis, Lewis et al. identified eight dimensions underlying the IRM construct: CIO, planning, security, technology integration, advisory committees, enterprise model, information integration, and data administration. Lewis et al. (1995, p. 200) stated, "The instrument serves two functions: (1) to create a coherent, theoretical foundation for further research on the IRM construct, and (2) to provide reference norms".

Information Resource Management Defined by the United States Federal Government

The US Federal government implemented information resource management in the mid-1970s in an attempt to diminish the paperwork burden on the general public (Lytle, 1986). As indicated by the longevity of the government's IRM definition as compared to those in literature, the US federal government's attempts to define IRM have not been as extensive, relentless, or meticulously executed. The Office of Management and Budget (OMB) Circular A-130, published in 1985 defines IRM as:

> The term "information resources management" means the planning, budgeting, organizing, directing, training, and control associated with government information. The term encompasses both information itself and the related resources, such as personnel, equipment, funds, and technology (Owen, 1989p. 20).

The revised version of the same document, published in 1996 actually degrades the specificity by using a recursive definition. The first sentence of the previous federal IRM definition was changed to read "the term 'information resource management' means the process of managing information resources to accomplish agency missions" (Office of Management and Budget, 1996). Furthermore, each public agency at the federal level relies on the same official IRM definition. AF Directory 33-303, Compendium of Communications and Information Terminology (Department of the Air Force [DoAF], 2002a, 143), for instance regurgitates the updated, yet still broad and recursive, definition from section 3502(7) of Title 44, US Code. The addition of the phrase, "and to improve agency performance, including through the reduction of information collection burden on the public," to the end of the first sentence of the previous IRM definition represents the only change.

The Chief Information Officer Function

The CIO is the senior information resource manager (IRMer) in an organization. "In the vernacular, the term CIO … is often used interchangeably with … Director of Information Resources" (Grover, Jeong, Kettinger, & Lee, 1993, p. 108). The CIO function is therefore intimately linked with the IRM construct and must also be reviewed for this research.

Synnott and Gruber coined the term "chief information officer" as used today in 1981 (Romanczuk & Pemberton, 1997). At that time, they defined the CIO as "a senior executive responsible for establishing corporate information policy, standards, and management control over all corporate information resources" (Synnott & Gruber, 1981, p. 66). The CIO function has been the subject of many academic studies and business articles since the concept and term emerged (Benjamin, Dickinson, & Rockart, 1985; Earl, 2000; Emery, 1991; Stephens, Ledbetter, & Mitra, 1992; Woldring, 1996). However, the term still maintains a similar meaning. CIOs are "responsible for all of their organization's information assets and associated technologies" (Smith, 2002, p. 71).

The CIO in the federal government.

The Clinger-Cohen Act (CCA) of 1996, also known as the IT Management Reform Act, established the position of the CIO within the federal government. In fact, the act mandated that federal agencies create a position whose sole function was to act in the CIO capacity. The DoD responded by establishing CIOs in each of the armed services. Although the OMB characterizes the CCA as "a comprehensive approach for executives to improve the acquisition and management of their information resources" (1996, sec 5), the CCA focuses on IT and the acquisition process, not IRM. In fact, the CCA refers to same federal government definition of IRM given above (section 3502(7) of Title 44, US Code). The definition leaves CIOs without clear, specific direction concerning their role as an IRMer.

Federal CIOs are not limited in action only to the responsibilities entailed in the CCA and similar legislation. Instead, Federal CIOs guidance regarding IRM has gone beyond the established confines of the legislation. Federal CIOs have added to IRM legislation in an attempt to improve the definition and practice of Federal IRM. In fact, the DoD CIO, Assistant Secretary of Defense for Networks and Information Integration (formerly Command, Control, Communications and Intelligence), endorses the IRM College (IRMC) of the National Defense University (NDU) (NDU: IRMC). The NDU instructs students in a program "directly related to the CIO competencies identified by the Federal CIO Council" such as leadership, strategic planning, etc. (NDU: IRMC) (see Figure 3), expanding the CIO concept beyond that found in current legislation.

Figure 3. NDU CIO Certificate Program Subject Areas

The AF-CIO.

The office of the AF-CIO also indicates architecture, process improvement, capital planning and investment, acquisition, performance measures, and strategic planning among its nine focus areas (2000). Interestingly, IRM is listed as its own focus area separate from all others. The AF-CIO defines IRM as:

> …a management function dealing with efficient management of information and data elements throughout their lifecycle. IRM encompasses the planning, budgeting, and supervising of the facilities, systems and organizations associated with government information in accordance with public laws and regulations. It covers both the information itself and related resources, such as personnel, hardware,

> software, funds, and technology. The Air Force's IRM program supports the delivery of Air Force programs and the conduct of internal management functions through the administration of computer, telecommunications and related technologies and management of forms, reports, and automated and manual information systems (DoAF: CIO, 2000).

This definition encompasses several of the other focus areas and many of the IRMC's principal topics considered essential for CIOs. However, the definition does not go far beyond that given in section 3502(7) of Title 44, US Code.

Information Resource Management Summary

Neither academic and business literature nor federal government documentation posit a single, universally accepted, specific, and complete model or definition of the IRM construct. In fact, the state of affairs has changed little from 1988 when Guimaraes stated IRM was described as having three schools of thought: IRM as the management of information as the resource; IRM as the management of individual information system development and improvement; and IRM as the management of the organization's resources, which produce information. However, the research conducted by Lewis, Snyder, and Rainer (1995) to provide reference norms for the IRM construct serves as a guide to future research. Lewis et al. identified 44 activities in eight dimensions associated with the IRM construct. Given the lack of a universal, coherent model or definition, the approach of Lewis et al. remains the most appropriate for identifying the key IRM dimensions for this research. The working IRM definition for this research will be constructed as an extension of Lewis et al.'s research in combination with further content analysis of the literature and documentation as described in the methodology.

Information Systems Implementation

Exploration of GeoBase implementation issues first requires the broader understanding of IS implementation issues. As background, previous research documenting IS implementation will be reviewed. An understanding of IS implementation issues shapes the expectations for challenges within GeoBase as a GIS-centric program.

IS implementation research develops factors which may impede or assist the implementation process. In doing so, behaviors of organizations, management, and individuals have been examined. Crescenzi (1988) applied the Japanese Seven Ss model to examine implementation across the organization. Focused through a strategic management lens, Wilson (1991) researched organizational IS implementation strategy. Kim and Lee (1991) also researched IS implementation from the aspect of management, individual behavioral management, based on the planned change theory. An examination of each area of IS implementation issues (organizational, managerial, and individual) factors affecting implementation follow, helping to predict implementation issues expected to be encountered as part of this research on GeoBase.

IS implementation issues: organizational factors.

Crescenzi (1988) cites organizational causes, not technological ones, as the primary reason for failed IS implementation. In fact, Crescenzi states almost all IS implementation efforts he studied “suffered from lack of support from senior corporate management” (1988, p. 14). He notes the human element of the organization was virtually ignored. As such, Crescenzi focuses on a balance of process, people, and tools for proper organizational management with respect to IS implementation. His focus led to an examination of critical organizational elements with respect to IS implementation using the Seven Ss model.

The Seven Ss model, originally developed by Pascale and Athos (1981) as a diagnostic model for organizational effectiveness, includes strategy, structure, skills, systems, style, staff, and shared values. In each category, different types of barriers to effectiveness (of primarily the implementation of corporate strategy) exist. Strategy is the organization's plan of action, which should dictate allocation of resources in an attempt to reach its objectives. Structure is the firm’s organization or departmental and managerial layout, the characterization of the organization chart. Skills reference the activities individuals in the business do well, the distinctive capabilities of the personnel or the organization. Systems include the ways in which managers move information around the organization, make decisions, and implement change. Style refers to the firm’s culture or the patter of behavior displayed by important individuals in the organization, especially its leadership. Staff is the composition of players involved or the demographics of the key personnel, the implementation team in this case. Shared values represent the overriding purposes to which an organization and its members dedicate themselves and use as a guide for action, also known as superordinate goals (Pascale & Athos, 1981).

Crescenzi (1988) studied the implementation of 30 strategic systems using the Seven Ss model. As a result, he identifed factors in each category which either contribute to or detract from successful implementation. Factors identified as leading to success include top-down management strategy, a strategic focus of business goals, selling and teaching skills, and not demanding perfection (imperfect is okay). Barriers to success included lack of a project champion, total architecture before implementation, focus on only technical skills, and strict accounting of return on investment. See Table 1 for an overview of Crescenzi's elements of IS success and failure. Crescenzi advocates a balance of the seven categories vice delving into the complexities of any single factor.

IS implementation issues: managerial factors.

Wilson (1991) invoked Porter's definition of strategy in order to research IS implementation as a total system, IS strategy – vice considering the technology or information strategy pieces separately. In researching IS implementation strategy, Wilson sought to "discover the importance attached to a variety of elements (1991, p. 39)." He identifies major impediments to the implementation strategy, during both set-up and execution, and ways to overcome the barriers. Measuring benefits, the nature of the business (degree of diversification, rapidity of growth, etc.), and political conflicts are

Table 1. IS Success and Failure Analyzed by the Seven Ss (adapted from Crescenzi, 1988)

	Strategy	**Structure**	**Skills**	**Systems**	**Style**	**Staff**	**Shared Values**
Elements leading to Success	Top-down Management	Team	Selling and Teaching Skills	Reward Risk Taking	All for One	Strategic Decision Maker as Champion	Unselfish, Persistent
	Focus on Business Goals		Tolerance for Ambiguity	Block Funding and Intuitive Justification	Loose, Flexible	Small Team	Give Away Ideas and Power
	Evolutionary Development		Liberal Arts Thinking	Use Informal Influences		Incorporate Both "Advocates" and "Assassins"	Imperfect is Okay
	Learning and Selling		Advanced Training				
Elements leading to Failure	No Project Champion in Management	Heirarchy	Technical Skills Only	Discourage Risk Taking	Individual Glory	No or Inappropriate Champion	We/They Separation
	Focus on System		Need Structured Problems	Strict ROI	Specific Job Duties	Superstar, not Team	Technical Excellence
	Total Architecture before Implementation		Inflexible	Failure to Head Off "Assassins"		"Assassins" Ready to Shoot	Perfection of System and User
	Nose to the Grindstone		Insufficient Education/Training				

among the top concerns (see Table 2). The "need to put a higher priority on the development of an overall systems and standards architecture", not applying "crude measures of money benefits … to areas of effectiveness", and building user-education requirements into systems development rank in the top five solutions (Wilson, 1991, p. 43). These IS implementation issues pertain to the management strata of an organization.

Barrier
Measuring Benefits
Nature of Business
Difficulty in Recruiting
Political Conflicts
Existing IT Investment
User-education Resources
Doubts About Benefits
Telecommunications Issues
Middle Management Attitudes
Senior Management Attitudes
Technology Lagging Needs

Table 2. Barriers to IS Implementation Strategy (adapted from Wilson, 1991)

IS implementation issues: individual factors.

Kim and Lee (1991) began their research with an extensive review of previous IS implementation studies. Through an examination of research conducted by Bostrom and Heinen, Keen, Kotter, Samek, and Zmud, among others, Kim and Lee identified over 15 variables or behavior obstacles associated with individuals. User education and training, effective communication, organizational climate, cooptation of users, and establishment of explicit IS objectives serve as examples of implementation issues stemming from individual factors repeatedly identified in literature (see Table 3).

A study by Kim and Lee (1991) of 109 application systems of 15 types from 57 businesses across six industries enabled them to categorize the behavior obstacles into four groups. As shown in Table 3, the implementation obstacles fell into four groups. Kim and Lee applied planned changed theory's concepts, based on Chin and Benne (1969), to determine the groups. After processing the data, three mutually exclusive groups representing each of the individual behavior strategies employed. An additional "unclassified" category also emerged and contained only two of the implementation factors (see Table 3).

Information Systems Implementation Summary

Literature cites implementation issues related to organizations, management, and individuals (Crescenzi, 1988; Kim & Lee, 1991; Wilson, 1991). As Kim and Lee state, generalizing the tangle of behavior obstacles to IS implementation into three succinct categories "could make it eas[ier] to establish an integrative contingent model relating the behavioral strategies of IS implementation (1991, p. 125)." Such a model would not necessarily capture the management and organizational issues. Recognizing the difficulty of capturing all the implementation issues in one framework, Crescenzi stated "[o]ne clear lesson is that developing and implementing [IS] is complicated (1988)." Organization, managerial, and individual issues must all be considered using appropriate constructs.

Factors	IS Implementation Management Variables
Power/Coercive Strategy	Reorganization of Reward System
	Cooptation of Users
	Application of OD Techniques
	IS Developers with Sufficient Authority
	Fixer with Full Authority and Resources
	Utilization of IS Experts or Consultants
	Operation of Steering Committee
Empirical/Rational Strategy	Selection and Deployment of Suitable Personnel
	User Education and Training
	Effective Communication between Users and IS Developers
	Users' Realistic Expectation for IS
Normative/ Re-educative Strategy	Organic IS Implementation Organization
	Organizational Climate Favorable to IS Use
	User Participation
	Activation of Learning Process of IS Use
Unclassified	System Design Coinciding with Organizational Power Structure
	Establishment of Explicit IS Objectives

Table 3. Varimax Rotated Factor Matrix of IS Implementation Variables (adapted from Kim & Lee, 1991)

The GeoBase program utilizes an IS and should be expected to encounter similar implementation issues as discussed in literature. Therefore, implementation issues on an individual, managerial, and organizational level may be reported. Issues may include elements of strategy, structure, politics, culture, human resource management (HRM), education, steering committees, and user participation among others.

Geographic Information Systems Background

GIS are a subset of IS designed for "capturing, storing, checking, integrating, manipulating, analysing and displaying data related to positions on the Earth's surface" (Howe, 1993). Because GIS provide the technological solution for GeoBase, a concise history of the development of GIS will first be presented. The capabilities and merits of GIS will also be mentioned. The nature of the GeoBase program will then be more fully explored.

Historical development of GIS.

Researchers pioneered the way from computer-aided drafting (CAD) to GIS in the late 1950s by linking CAD with emerging database solutions (Foresman, 1998; Goran, 2003). Instead of simply creating "dumb" maps, these pioneers exploited database capabilities to store "absolute locations of features as well as their spatial inter-relationships", creating a "smart" product (Cullis, 2000b; DoAF: HAF-GIO, 2003a). Further development during the 1970s led to a worldwide explosion of GIS use in the following decades (Cullis, 2000b; Foresman, 1998). Figure 4 relates the spectrum of organizations, and their relationships, involved in GIS development during this time of rapid growth. "With a stable core technology, the 1990s saw an exponential increase in the number of disciplines developing applications specific to their fields" (Cullis, 2000b). Cullis (Cullis, 2000b) and Foresman (Foresman, 1998) report these GIS solutions or applications are currently deployed on a local and enterprise-wide basis in countries around the globe.

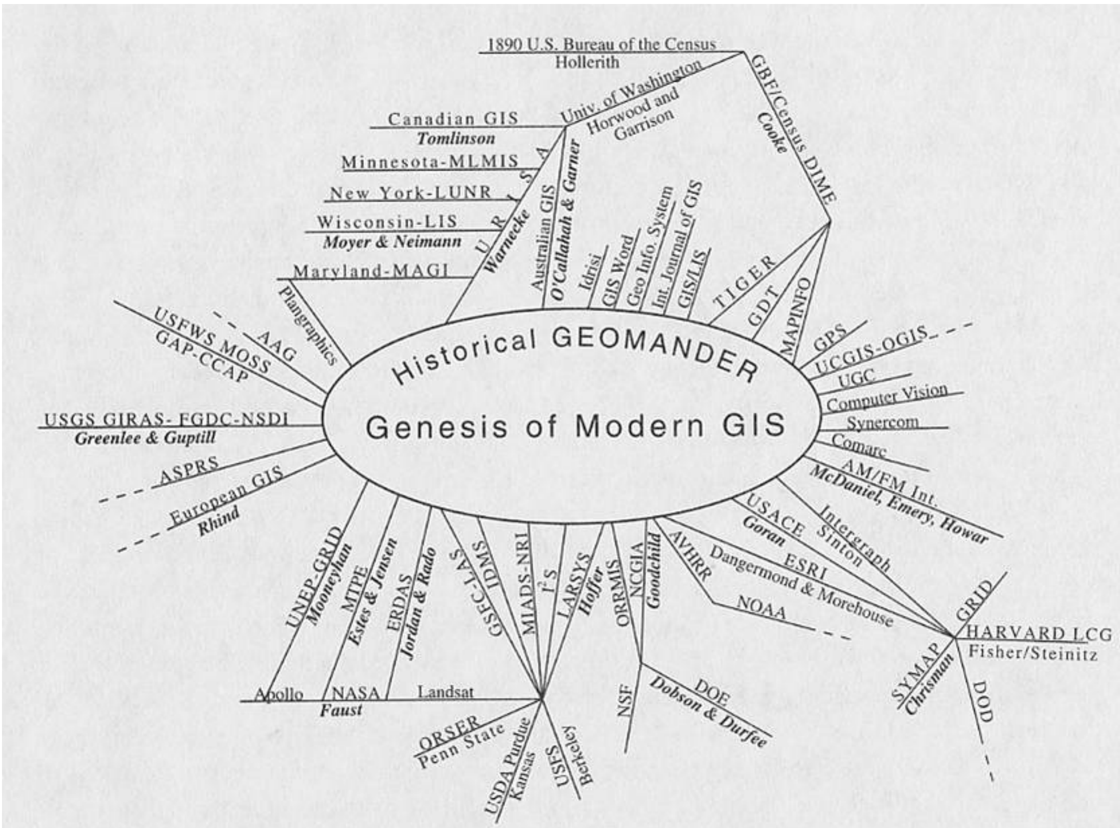

Figure 4. Diagram of historic pathways and connections for the genesis of modern GIS (Foresman, 1998)

Capabilities of GIS.

Three features can be modeled in a GIS: points, lines, and polygons (Blaise & Gessler, 1991). For example, a point could be used to locate a manhole, a line might designate a buried cable, and a polygon could represent the area of a building. A GIS also attaches attribute information to each of these geographic features (Blaise & Gessler, 1991). For example, information about a building (building number, hazardous materials stored within, communication nodes housed inside, etc.) could be assigned as attributes of the polygon in the GIS database representing the particular building (Fonnesbeck, 2003). Users not only have access to a CAD representation of the physical world, but also any additional information associated with the features on the map and stored as attribute data (Fonnesbeck, 2003).

The power of a GIS may be its ability to sort geographic features onto separate, selectable layers (Howe, 1993). As any geographic area contains various, classifiable features dispersed throughout its physical area (i.e., communication lines, buildings, flora, bodies of water, etc) and all such features, although of interest on the whole, may not be required by an individual, the ability to select only certain features is desirable for each given circumstance. For instance, bodies of water and trees, and their associated attributes (volumes, flow rates, type, etc), may be assigned to separate layers (Figure 5). Determination of river boundaries may be best achieved by removing the tree layer from the view, enhancing the ability to identify the river's edge (Fonnesbeck, 2003).

Dramatic advancements in global positioning system (GPS) technology in recent history have created "incalculable efficiencies … through new applications exploiting accurately georeference information" (Cullis, 2000b). GIS represents one such application of these advancements. Cullis also discussed the ramifications of remote sensing, which is used to produce sub-meter digital imagery used in geospatial applications. GPS, remote-sensing digital imagery, and GIS combine synergistically to create a robust tool for geospatial applications, from which USAF personnel are eager to benefit.

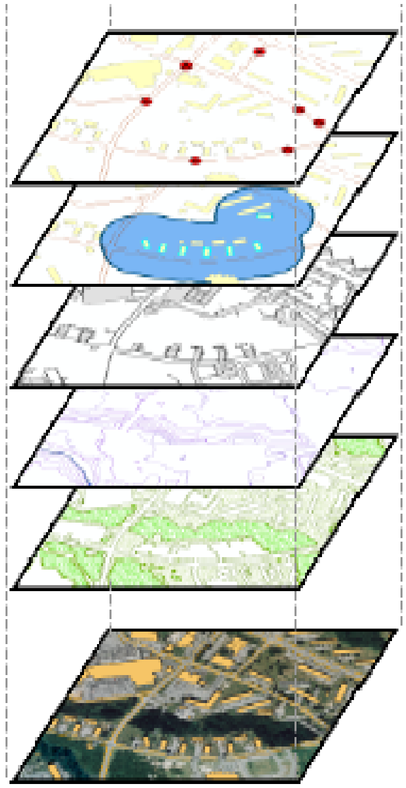

Figure 5. Seperate, selectable layers of GIS application (adapted from DoAF: HAF-GIO, 2003a)

GIS in the USAF.

USAF personnel quickly began integrating GIS systems into applicable work functions such as management of installation maps by CE and environmental managers (Cullis, 2000b). Independently, organizations collected spatial data, digital maps, hardware, and software for use in their particular units and functional areas (Cullis, 2000b; Zettler, 2002). Resources were wasted by populating redundant databases and multi-ordering base aerial photographs (Cullis, 1995; Fonnesbeck, 2003). The databases also had inconsistencies created by the timeliness of updates, attribute definitions, and similar conflicts (Cullis, 2000b; Fonnesbeck, 2003). Without a unified direction or coordinating force regulating GIS use, issues with data standardization, maintenance, and accuracy developed across the installations comprising the USAF (Cullis, 2000a, 2000b). Senior leadership was unable to obtain complete and accurate GIS data when necessary (Cullis, 2000b; Zettler, 2002). In addition, necessary resources to address these data issues were not sustained (Fonnesbeck, 2003). Policy, personnel, and funding were scant (Cullis, 2000a). Furthermore, US returns of developed land to the host nation in Okinawa created a dramatic management need due to the massive inundation of an estimated 1,000 separate construction contracts (Forbes, 2000). Problems with the GIS effort within the USAF were readily apparent (Cullis, 1995). The HAF-GIO was created in response to the need for a centralized point of attack to strategically address the problems developing in the USAF GIS implementation (Cullis, 2000b; Zettler, 2002).

The GeoBase Program

The GeoBase program is a collection of personnel at the USAF headquarters, MAJCOM, and base-levels with the mission to "attain, maintain, and sustain one geospatial infostructure supporting all installation requirements" (Zettler, 2002). First and foremost, GeoBase is "not a system--it is an [IRM] process" ("Garrison Mapping Capability Model", DoAF: HAF-GIO). GeoBase represents the implementation of GIS solutions in a unified, interoperable manner across all functional areas. GeoBase uses "disciplined creation, management, and sharing of critical geo-referenced information through modern mapping processes" to deliver "an accurate installation mapping service to major information systems” ("Garrison GeoBase Overview", DoAF: HAF-GIO). The GeoBase vision, “One Installation … One Map”, succinctly summarizes the program’s goal ("What is GeoBase?", DoAF: HAF-GIO).

The single map database created under the GeoBase concept is realized in the common installation picture–the visualization of cross-functional data in a single application (Figure 6). To accomplish the GeoBase vision, HAF-GIO defines the policy, guidance, and architectural frameworks. The MAJCOMs and their respective installations implement HAF guidance, adapting it to their particular situations. GIS technical solutions, the tools, provide the capability to accomplish this vision and mission (Cullis, 2003a).

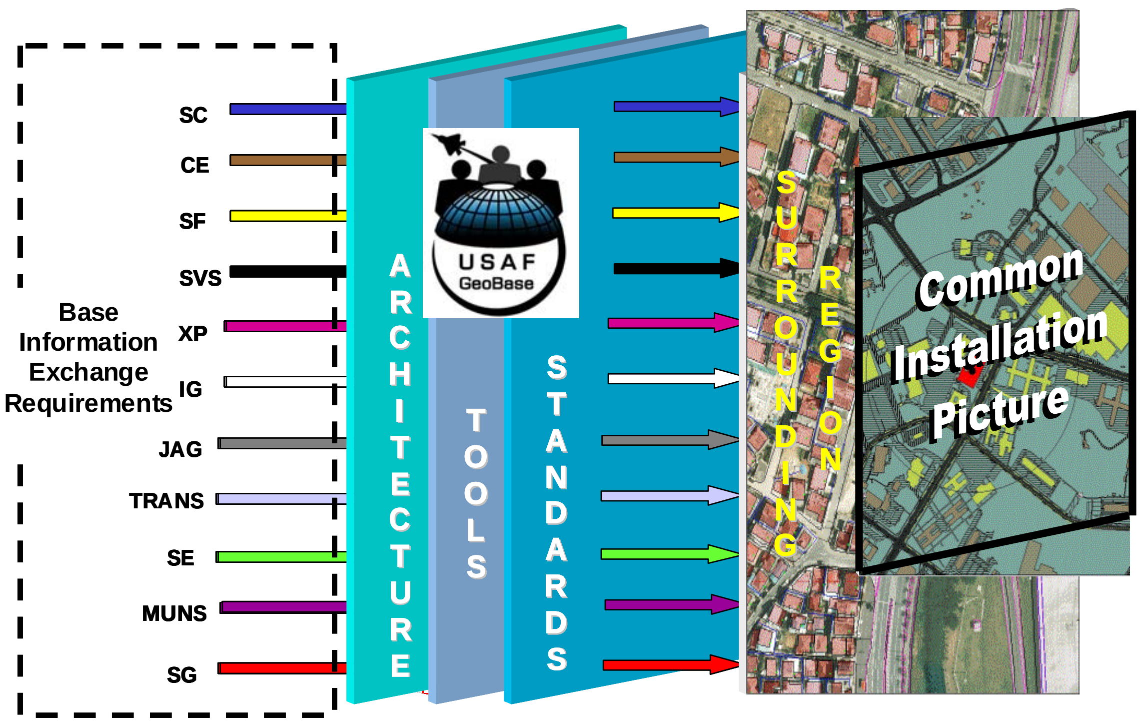

Figure 6. Common Installation Picture (Cullis, 2003a)

The entire GeoBase program includes the components of GeoReach, Expeditionary GeoBase, Strategic GeoBase, and Garrison GeoBase. GeoReach includes a broader focus including additional intelligence information to facilitate planning and accelerated bed-down of base infrastructure and support, aircraft, equipment, and personnel at a new forward operating location (Cullis, 2003c). Expeditionary GeoBase consists of a slimmed down, deployable version of the in-garrison product to provide situational awareness at new forward bases (Cullis, 2003c). Strategic GeoBase delivers a more generalize, filtered view of the Garrison GeoBase imagery and data to facilitate a regional awareness (Cullis, 2002b). Garrison GeoBase deploys one digital reference, high-resolution imagery map of cross-functional, base-level operations throughout a single installation (Cullis, 2002a) (Figure 7). Although a single entity may implement more than one component of the GeoBase program, the focus in this research remains the in-garrison program and will be referred to simply as "GeoBase". The GIS and IRM elements of GeoBase are of interest.

Geographic Information System Implementation Issues

GeoBase has been described above as a program reliant on GIS as the technical solution. Therefore, implementation issues specific to GIS must be examined. A review of the literature shows GIS implementation issues do not vary significantly from those cited for IS in general. For instance, Innes and Simpson (1993) submit simplicity in implementation, observability of benefits, and systems compatibility as key issues. Da

Villa and Panizzolo (1996) found user participation, integration with other systems, and personnel training to be critical factors. An OMB sponsored E-Gov initiative, the

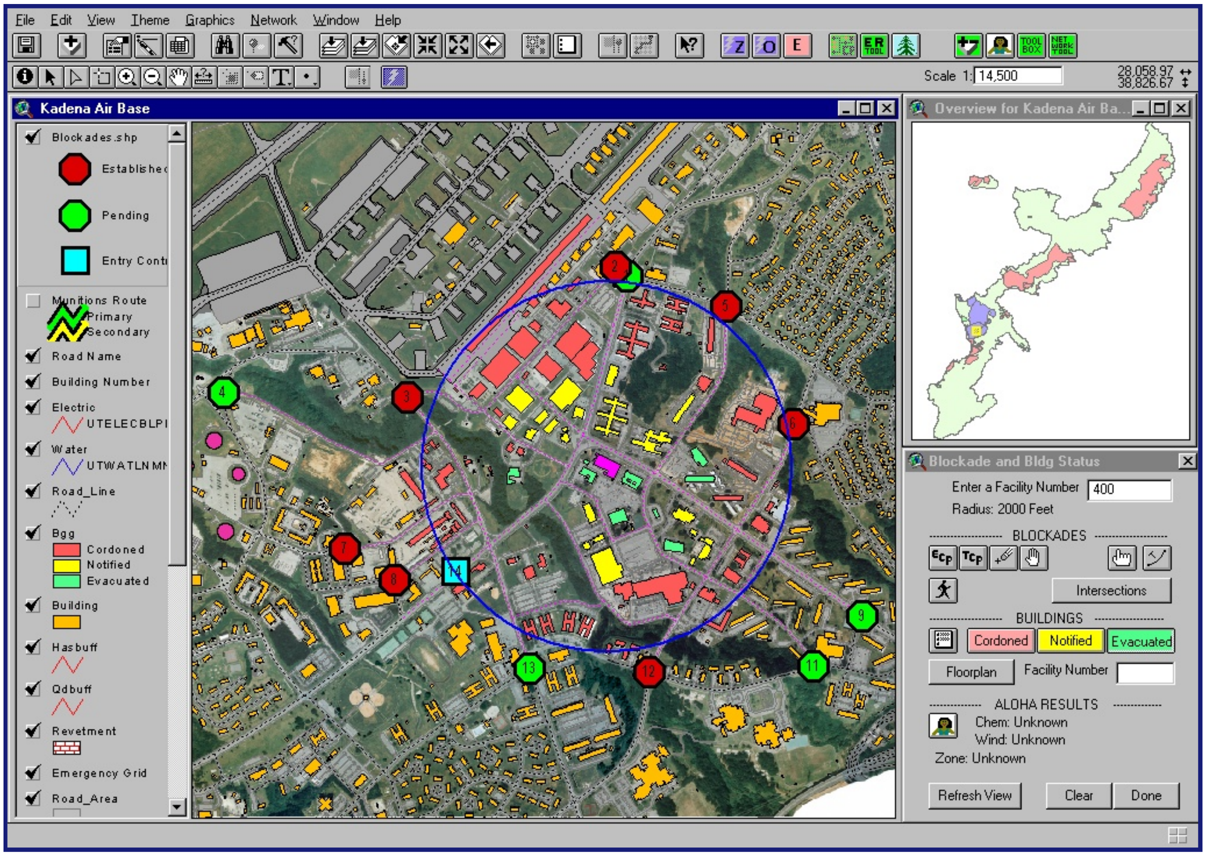

Figure 7. GeoBase Integrated Map Interface (Cullis, 2003a)

Geospatial One Stop lists effective data standards development, meeting public need for increased access to geospatial data, and an interoperable geospatial portal as its critical success factors (Industry Advisory Council Geospatial One Stop Best Practices Task Force, 2002). The items presented in all of these documents fit succinctly within those discussed in the IS implementation section. The research should expect to encounter issues relating to training, user participation, systems architecture, and measurability of benefits for example.

Known GeoBase Implementation and Information Resource Management Issues

Initial contact with the HAF-GIO staff, attendance of the GeoBase Compass Conference (an annual top-to-bottom gathering of all the GeoBase stakeholders), and a review of documents demonstrate that the program is designed to avoid the obstacles identified in the IS implementation section. Furthermore, the current leader of the GeoBase program, Col Brian Cullis, HAF-GIO, has studied IT implementation and adoption on multiple occasions (Cullis, 1995, 2000a, 2000b). His documented studies provided an initial framework for the GeoBase program. IRM, the focus of the program, represents one measure employed to avoid potential pitfalls (Zettler, 2002).

The anecdotal GSM.

Using empirical evidence, the HAF-GIO, through empirical evidence, developed the GeoBase Sustainment Model (GSM) to represent the IRM tenets of the program and implementation issues experienced by program personnel (B. J. Cullis, personal communication, March 15, 2003). In addition to the model, various documents capture the challenges, both experienced and expected, and IRM principles of the program (DoAF: HAF-GIO, 2002; 2003a; 2003b). The model, program challenges, and IRM principles documented will be discussed.

The GSM contains six pillars resting on the “USAF GeoBase Foundations” and supporting the four GeoBase programs (Figure 8). Setting a solid base, USAF GeoBase Foundations captures the basic tenets of the program. “Focus on Culture Change”, “Value GeoBase Resources as Vital Mission Assets”, and “Hold GeoBase Data Stewards Accountable” represent some of these fundamentals (Cullis, 2003c, p. 11). Atop the

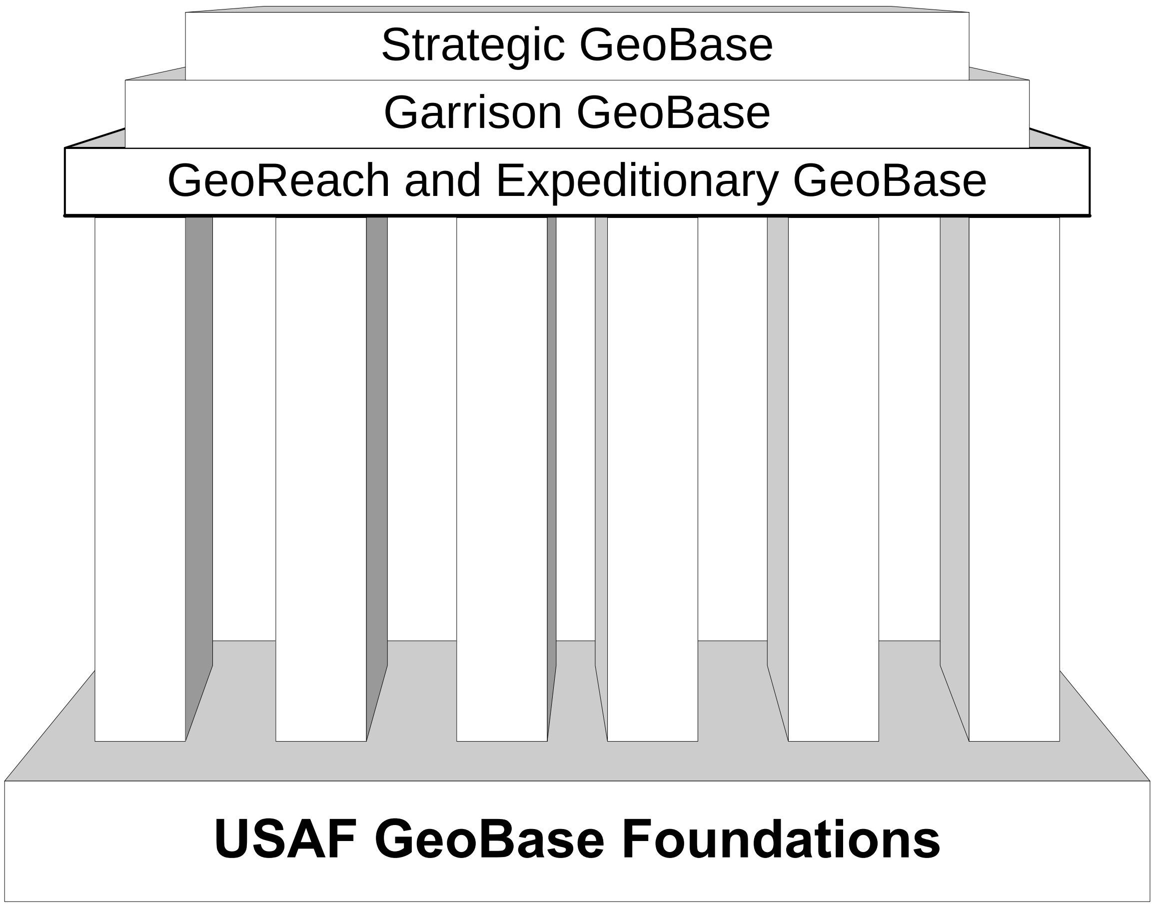

Figure 8. GeoBase Sustainment Model (adapted from Cullis, 2003c)

pillars, the three geospatial concepts rest. “GeoReach and Expeditionary GeoBase” provides a global mobility task force the capability to deliver one map to forward operating locations in the contingency environment (Cullis, 2002b, 2003c). The focus of this research, “Garrison GeoBase” provides a common installation picture to garrison bases (Cullis, 2003c; DoAF: HAF-GIO, 2003a). “Strategic GeoBase”, the final program, provides a filtered view of key Garrison GeoBase information over a larger geographical area for greater situational awareness of the base's region by the Air Staff (Cullis, 2002b, 2003c). Each of the pillars captures potential or experienced challenges or both.

The first pillar in the model, "Systems Architecture", responds to Federal mandates such as the CCA. Driving the GeoBase architecture, System Architecture "sets IT standards for acquiring, deploying, and assuring common GeoBase capabilities" (Cullis, 2003c). Similarly, "Information Architecture" defines the standards for the imagery, data, metadata, and applications associated with GeoBase (Cullis, 2003c). Bridging the gap from the foundations to the programs, "Policy & Guidance" sets standard operating procedures and the concept of operations in a more general sense than the preceding architectures (Cullis, 2003c). As the name implies, "Education & Training" denotes the knowledge necessary for designers and operators to implement and sustain GeoBase (Cullis, 2003c). "People & Workflow" addresses what employees (active duty, USAF civilian, or contractor) are required to manage and coordinate GeoBase activities, how those employees are organized and staffed, what their responsibilities the employees have, reward systems, and so forth (D.H. Feinberg, personal communication, June 2, 2003). "People and Workflow" also defines how personnel will coordinate with and assist functional communities and how the tasks of a process will be executed through business process mapping (B. J. Cullis, personal communication, November 18, 2003). A major focus for enterprises, "Financial

Management" covers IT portfolio management to include acquisitions and maintenance of systems hardware, software, personnel, and facilities (Cullis, 2003a).

Previously documented GeoBase IRM.

Few sources document existing IRM within GeoBase. In a memorandum to all USAF MAJCOMs, field operating agencies, and direct reporting units, the USAF Deputy Chief of Staff for Installations and Logistics (AF/IL) called for efficient organization of information resources to maximize outcomes from a limited budget (Zettler, 2002). He stipulated data administration, strategic planning, and IT standards should be implemented. To balance standardization practices with innovation, the HAF-GIO has implemented a "Federalist" IRM strategy (Feinberg, 2002). Centralized architecture coupled with decentralized implementation and limited local autonomy manifest the balance. Eliminating redundant, duplicative development; preventing unique, hard-to-share solutions; averting unwarranted capabilities amplifying the resource constraints; and providing consistent GeoBase service remain top concerns given the federalist IRM strategy (Feinberg, 2002). In the GeoBase concept of operation (CONOPS), the HAF-GIO further delineates his IRM strategy. The document states the following GeoBase objectives (DoAF: HAF-GIO, 2003a).

- balanced attention to organizational and technological issues to ensure long-term successful adoption
- ensure … information resource investments are inventoried, managed, and exploited … to avoid wasteful redundancies

- Secure fiscal accountability and reduce investment risk [through] strategic plans
- Implement a single set of geospatial information architectures and data quality assurance standards that maximize interoperability

The GeoBase architecture strategy specifically implements the last objective (DoAF: HAF-GIO, 2003b).

Previously documented GeoBase implementation issues.

Several possible obstacles to GeoBase implementation and success have been noted. Recently, the HAF-GIO has focused on the lack of metrics for measuring operational capability of the implementation effort (Cullis, 2003b). He also notes the process by which people acquire and sustain GIS technology is not well-defined (Cullis, 2003b). Perhaps more of a cultural barrier, overcoming stove-piped organizations and systems represents a challenge magnified in the information age (DoAF: HAF-GIO, 2002). Version 2 of the GeoBase CONOPS reiterates the functional stovepipes, fragmented or reduced situational awareness, inconsistencies in capabilities across the USAF, and redundant investments as known implementation issues (DoAF: HAF-GIO, 2003a). The CONOPS also lists challenges meeting the business goals, focus on IT rather than the mission, and a lack of focus on sustainment.

GeoBase Summary

The trend of inadequacies and failures in the GIS arena as described in the GIS background section gave rise to GeoBase. Because GeoBase leadership reviewed the causes for these previous failures, many of the potential pitfalls and possible solutions were known. As described above, the program has identified several challenges and areas for improvement. Its documents are also rich with IRM practices geared toward success. The GSM attempts to capture both the areas of risk (implementation issues) and mitigation (IRM) as seen by the GeoBase leadership. The model will be the center piece of this research as described next in the methodology.

Summary of Literature Review

The completion of this research requires an understanding of several topics. In this chapter, previous attempts to define IRM were reviewed. A commonly-accepted, comprehensive definition of IRM was found, requiring the researcher to define IRM as part of the research effort. To fully understand the GeoBase program, the topics related to its technology solution and history were introduced. A review of IS implementation provided a set of implementation issues to be expected. Refining the expected implementation issues further, GIS implementation issues were also reviewed. Drawing closer to the actual topic for research, a short history of GIS development was presented. This led to the discussion of the GeoBase program itself. The GSM was introduced along with known GeoBase implementation issues.

Chapter III. Method

The methodology describes the research process necessary to properly answer the research questions in a reliable and repeatable way. "There needs to be some systematic way of relating the data and the interpretations placed on them … to avoid rabbit-out-of-the-hat conclusions" (Sauer, 1993, p. 138). In this chapter, the rationale for choosing the methodology, research design factors, data collection, and design quality issues will be discussed. Case study methodology will be employed as the backbone for this research. Elements of content analysis will also be briefly discussed due to its use in the research.

Rationale for Choosing Case Study

The case study design has been described as the optimal methodology when the "phenomenon under study is not readily distinguishable from its context … [for] example a complex interaction between a phenomenon and its (temporal) interaction" (Yin, 2003a, 4). Due to the complexity of the interaction and the richness of the context, the study may have more variables than data points (Yin, 2003a). The researcher, therefore, "(a) attempts to gain insights about the nature of a particular phenomenon, (b) develop new concepts or theoretical perspectives about the phenomenon, and/or (c) discover the problems that exist within" it (Leedy & Ormrod, 2001, 148). As such, the case study "may be especially suitable for learning more about a little known or poorly understood situation" (Leedy & Ormrod, 2001, 149). A multiple-case study also allows for comparisons, theory building, or proposition of generalizations (Leedy & Ormrod, 2001). "In conducting a case study, the complex social and political web in which computing developments are undertaken becomes salient" (Sauer, 1993, p. 133). Both Leedy and Ormrod and Yin offer more precise determinations of when the case study might be appropriate.

Leedy and Ormrod's criteria for selection of methodology.

Leedy and Ormrod (2001) first delineate between qualitative and quantitative approaches before discussing particular designs. In order to determine which approach best applies to a particular research situation, Leedy and Ormrod discuss five research characteristics: purpose, process, data collection, data analysis, and reporting findings. Each characteristic will be evaluated.

Purpose is divided into two categories: qualitative and quantitative. Qualitative researchers seek a better understanding of complex situations. Quantitative researchers attempt to provide explanations and predictions. Seeking to more fully understand the GeoBase program with respect to implementation issues and their relationship to IRM and the GSM, this research is more qualitative in nature (Leedy & Ormrod, 2001).

Leedy and Ormrod (2001) also state qualitative research processes tend to be emergent, holistic, and immersed in the phenomenon. On the other hand, quantitative processes follow more structured guidelines and uses objective measurements detached from the situation. Although a theoretical base exists, this research examines emergent phenomena and is suited to a qualitative process.

Data collection varies in accordance with the variables of interest. For instance, well-defined variables would allow the use of standardized instruments targeted specifically for the variables. The variables in this study are not well defined and sway the design toward a qualitative one (Leedy & Ormrod, 2001).

Data analysis also varies depending on the variables. When reality cannot be easily divided into discrete variables, the researcher tends to rely on making generalizations from many observations of a smaller sample using inductive reasoning as in qualitative research. The lack of research in this particular area leaves the researcher with variables that do not lend themselves to quantization. A qualitative design is therefore more appropriate (Leedy & Ormrod, 2001).

Leedy and Ormrod (2001) also consider the researcher's own characteristics important when recommending a particular research approach. As depicted in Table 4, many of the characteristics of quantitative and qualitative approaches are revisited. The audience, researcher, literature, time available, and the researcher are all considered. Excepting the time available and the researcher's greater affinity for structured, deductive research, the decision criteria strongly favor a qualitative approach. Leedy and Ormrod (2001) discuss four qualitative designs, which will be explored in the following paragraph.

Leedy and Ormrod discuss several designs in each approach, allowing the researcher to determine which method may be best. As this research more closely meets the criteria expressed for qualitative research, only qualitative designs discussed by Leedy and Ormrod were extensively examined. These designs include case study, ethnography, phenomenological study, and grounded theory. "Of all the research designs [described] … a grounded theory study is the one that is least likely to begin from a

Use this approach if:	***Quantitative***	***Qualitative***
1. You believe that:	There is an objective reality that can be measured	There are multiple possible realities constructed by different individuals
2. Your audience is:	Familiar with/supportive of quantitative studies	Familiar with/supportive of qualitative studies
3. Your research question is:	Confirmatory, predictive	Exploratory, interpretive
4. The available literature is:	Relatively large	Limited
5. Your research focus:	Covers a lot of breadth	Involves in-depth study
6. Your time available is:	Relatively short	Relatively long
7. Your ability/desire to work with people is	Medium to low	High
8. Your desire for structure is:	High	Low
9. You have skills in the area(s) of:	Deductive reasoning and statistics	Inductive reasoning and attention to detail
10. Your writing skills are strong in the area of:	Technical, scientific writing	Literary, narrative writing

Table 4. Selection of research approach (adapted from Leedy & Ormrod, 2001)

particular theoretical framework" (Leedy & Ormrod, 2001, p. 276). The IRM construct and GeoBase program already have established theoretical frameworks. In addition, the focus of a grounded theory study tends to be human interactions. This is not necessarily suited to the objectives of this research. Similarly unsuited, phenomenological designs study an experience from the participant's perspective. Ethnographic designs were also dismissed due to a focus on understanding group culture at a specific field site. However, case studies intend to understand a situation, or small number, in greater depth. Case studies examine a phenomenon using one or a few instances in the natural setting. Given the treatments explained, the case study method best matches the objectives of this research (Leedy & Ormrod, 2001).

Yin's criteria for selection of methodology.

Yin (2003b) defines five basic research strategies: experiment, survey, archival analysis, history, and case study. According to Yin, three purposes of research exist: exploration, description, and explanation. He argues that each strategy can be applied to all three purposes. Instead of the traditional hierarchical stratification of research strategies singularly matched to the purpose, Yin calls for a methodological choice based on "(a) the type of research question posed, (b) the extent of control the investigator has over actual behavioral events, and (c) the degree of focus on contemporary as opposed to historical events" (p. 5).

The determination to use the case study method required an examination of the study with respect to each of Yin's (2003b) three conditions. First, Yin recognized a basic categorization schema for questions: who, what, where, how, and why. He then discussed the implications of each category. For "what" questions, Yin establishes two divisions. One division contains the exploratory type of "what" questions. The other division holds "what" questions that are actually a form of "how many" or "how much". Whereas this second division of "what" questions can be readily enumerated and favor surveys or archival analysis, this research uses the exploratory form of the "what" question. Yin, as stated above, does not favor a particular strategy based solely on the research purpose. Instead, Yin's next criterion, the extent of control over behavioral events, had to be examined. Experiments are not suitable when the investigator cannot manipulate the behavior directly. The researcher has no control over the phenomenon of study (the GeoBase program implementation) and must eliminate experimentation as a possible strategy. Finally, the temporal question further pares the strategies. Case studies alone of the remaining methods focus on contemporary events. Yin also states case studies are appropriate for answering "how" questions, which are included in this research, making it the superior strategy to answer all of the research questions posed (Yin, 2003a).

Case Study Design

A research design develops a logical plan for taking the proposed questions to conclusions. For the case study, Yin identified five components in the design: the study's questions, propositions, unit(s) of analysis, logic linking data to propositions, and criteria for interpreting the findings. Each component will be discussed in more detail as it pertains to this research.

Study questions.

The following research questions were submitted in the introductory chapter as necessary to meet the purpose of the research:

1. What are the current key GeoBase implementation issues as reported by MAJCOM GIOs?
2. How do these reported issues compare to the implementation issues represented by the HAF-GIO in the GSM?
3. What are the key dimensions of the IRM construct as it applies to this research?
4. How does the current GSM compare to the key dimensions of the IRM construct?
5. How does the GeoBase Program, as represented by the GSM and as currently implemented, address key dimensions of IRM as specified by the Federal Government?
6. What changes, if any, are required to update the current GSM?

As discussed above, these "what" questions develop an exploratory research stream. Although they capture the areas of interest, these "questions do not point to what [one] should study" (Yin, 2003b, p. 22). The second design component defines more clearly where to look for relevant evidence (Yin, 2003b).

Study purpose.

Yin (2003b) states, "the design for an exploratory study should state [its] purpose, as well as the criteria by which an exploration will be judged successful" (p. 22). The purpose of this research is to qualitatively assess or validate the GSM. As the model relates GeoBase IRM competencies and implementation issues, qualitative validation of the model will cover both the IRM and implementation aspects. The study will be considered a success if analyzed implementation data collected from three MAJCOMs is used to assess the GSM's representation of GeoBase implementation issues. In addition, the GSM must be validated with respect to an operationalized IRM construct for this research to be successful. Submission of results with any suggested changes to practitioners will be the final indication of success.

Case design and the unit of analysis.

Yin (2003b) describes two decision points necessary when considering the case and the unit of analysis: single- vs. multiple-case and holistic vs. embedded. Usually, a single-case design is used when the case is critical, unique, typical, revelatory, or longitudinal. Researchers typically implement multiple-case designs when the cases do not meet the single-case criteria and the investigator seeks to increase the reliability through replication. Once the decision between single- or multiple-case is made, the researcher must decide between a holistic and embedded. Embedded designs involve more than one unit of analysis within each case. The unit of analysis mirrors the case in a holistic design (Yin, 2003b). As described in the following paragraphs, this research implements a multiple-case design with MAJCOM GIOs as the unit of analysis. Selection of case design and the unit of analysis begins with case selection.

Case selection is one of the most difficult research steps. "When uncertain about this process, the elaboration of theoretical issues related to the objectives of the study can provide essential guidance" (Yin, 2003a, p. 9). Yin (2003b) provides further guidance for the selection of an appropriate case, emphasizing the specificity of the primary research question.

Consideration of IS implementation theory and the primary research question dictate the case selection, which is the first step in choosing between single- and multiple-case designs. With respect to this research, previous IS and GIS implementation theory building works indicate the users and the project team bear the knowledge of implementation issues (Cooper & Zmud, 1990; Crescenzi, 1988; Kim & Lee, 1991; Wilson, 1991). The users in this case were the same as the project team: base and MAJCOM-level GIOs. The HAF-GIO suggested the degree of implementation at the base level was insufficient to support this study, so the MAJCOM level was selected (D. H. Feinberg, personal communication, 15 February, 2003). Furthermore, the primary research question requires all GeoBase implementation issues be catalogued. As many MAJCOM-GIOs should be included as is feasible. In addition, no single MAJCOM-GIO fit the criteria for a single-case design. A multiple-case design was therefore chosen (Yin, 2003b).

The unit of analysis must be determined once the case design decision has been accomplished. Again, two choices exist: holistic or embedded units of analysis. A predefined period of time, representing the contemporary time frame within which the collected data must fall, also describes the unit of analysis (Leedy & Ormrod, 2001).

Yin (2003b) recommends a holistic design for case studies that examine the global nature of a program. For instance, a case study of a single organization, such as a communications squadron, may provide analysis of individual flights. Outcomes regarding the individual flights of the greater organization, the squadron, demonstrate embedded analysis. Analysis performed solely on the squadron represents a holistic design. As no attempt was to be made to determine at which level or with which base of a MAJCOM a particular implementation issue occurred, a holistic design applies. Furthermore, data collection was primarily achieved through group sessions with MAJCOM personnel. Individual interviews were used to augment and clarify group sessions. No individual analysis was performed. Only the global nature of the GeoBase program from the MAJCOM perspective was examined (Yin, 2003b).

The time frame of the study must also be considered to fully specify the unit of analysis. With counsel from the selected MAJCOM-GIOs and the HAF-GIO, the researcher chose a period of 12 months ending in October, 2003. The GeoBase program has only been active a short time beyond the selected period. The one-year time frame limits the scope of the study to contemporary events as recommended by Yin (2003b).

The number of cases studied, the inclusion of subunits, and the time frame prescribe the case design and unit of analysis. As described above, a holistic multiple-case design was chosen. The units of analysis were therefore the same as the cases: the personnel assigned to the selected MAJCOM-GIOs. Data was constrained to implementation issues occurring in the year prior to October, 2003.

Linking data to propositions and criteria for interpreting the findings.

The fourth and fifth design components, linking data to propositions and criteria for interpreting findings, "foreshadow the data analysis steps in case study research"

(Yin, 2003b, p. 26). However, the design of an exploratory study does not necessitate propositions as described above in the section of the purpose of the study. The data was, therefore, linked back to the purpose through content analysis. Content analysis consists of a "detailed and systematic examination of the contents of a particular body of material for the purpose of identifying patterns, themes, or biases" (Leedy & Ormrod, 2001, p. 155). As criteria for interpreting findings, the researcher used the operationalized IRM construct and the current GSM for frameworks. The researcher sought patterns of themes with respect to IRM and the GSM as described later in this chapter (Sauer, 1993; Yin, 2003b).

Data Collection

Criteria for selecting cases.

"The idea of qualitative research is to **purposefully** select informants (or documents or visual material) that will best answer the research question" (Creswell, 1994, p. 148). As such, the limits described in the unit of analysis were applied without attempting to "randomly select informants" (Creswell, 1994, p. 148). The HAF Garrison GeoBase Manager assisted the researcher, directing him to USAF documentation and recommending particular sites for study, including Air Combat Command, Air Force Materiel Command, Air Mobility Command, United States Air Forces Europe, and Pacific Air Forces. To ensure more accurate and valid results, cases were chosen in an attempt to cover the spectrum of implementation stages and challenges. More information related to validity and reliability can be found in later in this chapter.

Data collection principles.

Yin (2003b) prescribes three principles for data collection. First, a "good case study will … use as many sources as possible" (Yin, 2003b, p. 85). Yin next advocates for a case-study database. Finally, he stipulates the research should maintain a chain of evidence similar to that of law enforcement officers. The following paragraphs describe the application of each principle within this research.

Yin states, "a major strength of case study data collection is the opportunity to use many different sources of evidence" (2003b, p. 97). In fact, he says case studies require multiple sources of evidence more than other research strategies. Yin defines six major sources of evidence: documentation, archival records, interviews, direct observations, participant observation, and physical artifacts. For this case study, documentation, archival records, interviews, and direct observations were used. More detail concerning the interview data collection follows in the section on design quality (Yin, 2003b).

Yin (2003b) strongly recommends the use of a case-study database for organizational purposes. In compliance with this recommendation, an electronic file containing all the literature, documentation, and data was created. The database file facilitates the separation of the interview and literature data, or evidence, and the research report of the investigator.

The research database leads to Yin's (2003b) third principle, maintain a chain of evidence. The database allows the raw data to remain untainted and free from manipulation. In addition, the documentation and literature contain the source information. All data and report elements can be traced back to the point of origin.

Design Quality

Readers, reviewers, and practitioners must be able to assess the worth of a proposal or research (Leedy & Ormrod, 2001). "Because a research design is supposed to represent a logical set of statements, you also can judge the quality of any given design according to certain logical tests" (Yin, 2003b, p. 33). Four tests are commonly used "to establish the quality of any empirical social research … the four tests are also relevant to case studies" (Yin, 2003b, p. 33). Establishing a causal relationship, internal validity is used only in conjunction with explanatory studies not descriptive or exploratory ones such as this research. The four tests, tactics for use, and appropriate research phase for implementation are summarized in Table 5 (Yin, 2003b).

Construct validity.

Establishing correct operational measures for the concepts being studied creates construct validity. To achieve construct validity, an investigator must specifically define the variables of interest, relate them to the study's objectives, and demonstrate the selected measures reflect these variables. Yin (2003b) lists three tactics to meet the test of construct validity: use multiple sources of evidence, encouraging convergent lines of inquiry; establish a chain of evidence; and have the draft study report reviewed by key informants. In fact, all three tactics were employed for this research. Details of the first two tactics are discussed in the section on data collection principles. Review of the draft study report will be discussed next (Yin, 2003b).

Tests	Case Study Tactic	Phase of research in which tactic occurs
Construct validity	• Use multiple sources of evidence • Establish chain of evidence • Have key informants review draft case study report	data collection data collection
Internal validity	• Do pattern-matching • Do explanation-building • Address rival explanations • Use logic models	data analysis data analysis data analysis data analysis
External validity	• Use theory in single-case studies • Use replication logic in multiple-case studies	research design research design
Reliability	• Use case study protocol • Develop case study database	data collection data collection

Table 5. Case Study Tactics for Four Design Tests (Yin, 2003b)

Several aspects of this study were reviewed by key informants during their draft phase. To begin with, the Site Visit Read Ahead document (Appendix C) was sent for review to the all 582 attendees of the 2003 GeoBase Compass Conference who provided an email address at registration. Of the 582 requests for review sent out, 60 were undeliverable and 11 recipients were out of the office. 41of the remaining 511 recipients replied (8%), though several respondents indicated their response was a compilation of input for the entire organization. Of the replies, 100 percent understood the questions as targeting the constructs of interest. Minor changes based on respondent input were made to further enhance the validity of the interview protocol. Once interview data was collected, informants were given the opportunity to analyze both the interview protocol and responses. No input was received to indicate the protocol did not target the constructs of interest. Finally, interview data and the draft report were submitted to subject matter experts in the IRM (Lt Col Summer Bartczak, Air Force Institute of Technology) and GeoBase (Mr. Daniel Feinberg, HAF GIO) arenas. The key informants confirmed the construct validity.

External validity.

External validity establishes the domain to which a study's findings can be generalized (Yin, 2003a). To determine whether research findings are generalizable beyond the immediate case study, Leedy and Ormrod (2001) cite two applicable strategies for external validity: use of a real-life setting and replication in different context. A case study naturally occurs in a real-life setting, satisfying the first strategy. As discussed previously, the research was conducted as a multiple-case design. The multiple cases allow for replication. Furthermore, Yin (2003b) calls for analytical generalizations, where the results use a broader theory as the basis for generalization. Yin (2003b) cautions that the generalization is not automatic and insists the theoretical generalization must be tested by the same replication logic underlying experiments. This study relies primarily upon replication to create external validity by context and theory through the use of a multiple-case design.

Literal and theoretical replication.

Replication in a multiple-case study design requires that each case must be selected such that it either predicts similar results (literal replication) or contrasting results for predictable reasons (theoretical replication). As such, each MAJCOM-GIO was selected by these criteria. Case selection was accomplished in conjunction with the HAF-GIO and resulted in three cases which have both similarities and differences (see Table 6). Highlighting the elements for literal replication, each case consists of a MAJCOM-GIO staff based in the continental US (CONUS) with a similar sized staff and budget. Base-level personnel composition and mission elements represent the most significant factors contributing to theoretical replication (Yin, 2003b).

Reliability.

Yin (2003b) describes reliability, whose goal is to minimize the errors and biases in the study, as follows.

> The objective is to be sure that if a later investigator followed the same procedures as described by an earlier investigator and conducted the same case study all over again, the later investigator should arrive at the same findings and conclusions (p. 37).

To accomplish this task, Yin states documentation of the procedures is the key. This chapter describing the methodology, the use of a case study protocol (Appendix B), and the database file served this purpose.

	MAJCOM A	MAJCOM B	MAJCOM C
Location	CONUS	CONUS	CONUS
No. of Sites	12	20	13
Est. Budget	Median	High	Median
Mission Focus	Garrison	Expeditionary	Garrison
Mission Cultural	Business	Combat	Logistics
Base-Level Personnel Type	Civilian	Military	Mixed
MAJCOM-GIO Staff Size	Small	Median	Small

Table 6. MAJCOM Comparison Matrix

Content Analysis Design

Content analysis provides a framework for data analysis within the case study design of this research necessary to answer the research questions. Therefore, content analysis must also be explored. The following paragraphs detail the use of content analysis in general as well as the specific coding scheme used for this research and its reliability. Although a complete methodology in itself, content analysis was used here to help guide the researcher to valid and reliable conclusions and ensure the repeatability of the study. The rigor of the study lies primarily in the case analysis design.

Use of content analysis.

Content analysis takes many words from a document and classifies them into much fewer content categories, “reducing [the document] to more relevant, manageable bits of data” (Weber, 1990, p. 5). For a proper analysis, a coding scheme must be created a priori. The scheme should ensure reliability of coding as well (Weber, 1990).

Nasirin and Birks (2003) found content analysis to be a sound and useful method for their case-study investigation of GIS implementation issues. Similarly, content analysis was used in this study to determine appropriate categories for the reported GeoBase implementation issues. It was also used to pattern match the determined implementation categories to the existing pillars of the GSM. Furthermore, content analysis provided the mechanism to generate the operational IRM construct from literature and documentation. Generation of the coding scheme and its reliability will be discussed in the following sections.

The coding scheme.

Weber (1990) provides a stepwise process to creating and using a coding scheme, which will be used for this study. First, the researcher must define the recording unit, the basic unit of text to be classified. The recording unit may vary from a single word to the entire text. After the recording unit has been established, the categories must be determined using two distinctions: (1) will categories be mutually exclusive and (2) will categories be narrowly or broadly defined. Weber prescribes testing of the scheme next using a small sample of test or actual data. Following testing, Weber suggests reviewing the coding rules. Any necessary changes, as indicated by testing, should then be made. Actually a feedback loop, Weber's next step redirects the researcher to the testing step. The "cycle will continue until the coders achieve sufficient reliability" (Weber, 1990, p. 24). Reliability has significance as defined by the researchers and will be discussed later in this chapter. When sufficient reliability has been achieved, the code is ready for use. The last step is to assess the coding process after coding has been completed.

Application of Weber's (1990) coding scheme process lead the researcher to the following. For this study, a theme created by contiguous phrases served as the recording unit. Themes, expressed in predefined categories, best suit the desired objectives of both a comparison of reported issues to the represented issues in the GSM and an operationalized IRM definition. The predefined categories for this research follow from these research objectives. The next two paragraphs describe these categories for the GSM and operationalize IRM construct, respectively.

The second research question calls for a comparison of reported implementation issues to issues represented by the GSM. As such, each pillar and the foundation of the GSM (Table 7) were defined broadly as the categories for the implementation issues. The categories, perhaps interdependent, were considered mutually exclusive.

Implementation Issue Categories
Information Architecture
Systems Architecture
Financial Management
Education and Training
Policy and Guidance
People and Workflow
Culture

Table 7. GSM Derived Implementation Issue Categories

The third research question dictates the IRM construct be operationalized from documents and literature. For this analysis of IRM, a matrix based from Lewis, Snyder, and Rainer's (1995) work was used to create the broad and mutually exclusive IRM categories necessary (Table 8). A preliminary review of the documents and literature augmented the categories established by Lewis et al prior to the final content analysis.

IRM Dimensional Categories
Chief Information Officer
Planning
Security
Technology Integration
Advisory Committees
Enterprise Model
Information Integration
Data Administration

Table 8. Major IRM Coding Categories (adapted from Lewis et al., 1995)

The fourth research question requires a comparison of the GSM to the operationalized IRM construct. For this endeavor, the categories established by the second and third research questions allowed a direct comparison. The more specific IRM categories were coded, or matched, with respect to the broader GSM categories.

The coding scheme, although develop a priori, must be adequate to fully analyze the material in question. Following Weber's recommendation, a small sample of the collected data was used to test the clarity of the category definitions and themes. The coding scheme did not require revision beyond the additional categories. Reliability of the content analysis is discussed in the next section (Weber, 1990).

Coding reliability.

Three types of coding reliability must be considered for content analysis: stability, reproducibility, and accuracy (Krippendorff, 1980). Also known as intercoder reliability, reproducibility "refers to the extent to which content classification produces the same results when the same text is coded by *more than one* coder" (Weber, 1990, p. 16). Low reproducibility could indicate ambiguous coding instructions or the lack of a shared understanding with respect to the constructs, themes, or categories. "[R]eferring to the extent to which the results of content classifications are invariant over time" (Weber, 1990, p. 16), stability can be assessed through multiple codings by the *same coder*. Inconsistencies in the coding represent unreliability. The strongest form of reliability, accuracy "refers to the extent to which classification of text corresponds to a standard or norm" (Weber, 1990, p. 16). The lack of established standard codings makes accuracy a seldom used measure.

This study employed all three types of coding reliability. To ensure reproducibility, the interviews were coded by multiple coders. Interviewees and the HAF-GIO Garrison GeoBase Manager were used as coders in these instances. Issues of low reproducibility were associated with a misunderstanding of the intent of the interview content. The reproducibility and correctness of the interview transcripts increased once any misunderstandings concerning the interviewee's intent was resolved. To test for stability, each interview set was coded not less than four times by each coder. All recording units were coded in the same category at least three of the four times. Due to the interdependencies of the categories and the open nature of interview responses, rare instances of inconsistent coding did occur. Such instances occurred where the recording unit was assigned a primary and secondary category. All inconsistencies consisted of the transference of the primary and secondary category designation. As with the case study as a whole, the content analysis ties back to theory as a means for reliability. The GSM and the operational IRM construct provided standard norms, increasing the accuracy of coding.

Summary of Methodology

This chapter presented the two methodologies employed in this research. Through a process of elimination, the case-study was shown to be the most appropriate methodology to determine the GeoBase implementation issues. The exploratory and contemporary nature of the research was the primary determinant for selecting the case study method. In order to answer the remainder of the research questions, a content analysis proved most useful. The content analysis methodology facilitated the formulation of the key IRM dimensions from literature and documentation. Content analysis also allowed the reported GeoBase implementation issues, key IRM dimensions, and GSM to be categorized and compared.

Chapter IV. Results

The case study interviews and review of literature and documentation produced a large pool of data. In this chapter, the analysis of that data will be presented. The arrangement will follow the outline of the research questions, leading up to the final analysis of the GSM as a whole from the perspectives of implementation issues and IRM in general and with respect to the Federal government.

Reported GeoBase Implementation Issues

The first research question required a determination of current GeoBase implementation issues. To identify what the implementation issues were, a multiple-case study examined GeoBase implementation at three MAJCOM headquarters (three cases). The data revealed numerous implementation issues for each MAJCOM. The primary issues for each case will be discussed. In addition, the issues common across multiple cases will be discussed. Significant differences between the cases will also be explored. The entire compiled and organized data reviewed by the informants and GeoBase expert is located in Appendix D, E, and F for MAJCOM A, B, and C respectively.

Appendix G contains the complete set of reported implementation issue categories. For the sake of brevity and clarity, the discussion in this section includes only the top categories. Histograms in this section are abbreviated, not including all issues reported by a particular MAJCOM. To assist in scoping the discussion, a visual analysis of the histograms provided a Pareto-like (20/80 distribution) interpretation of the categorized data. The items deemed most significant (roughly those in the top 20 percent of the distribution) are explored more fully in the following sections.

Reported issues at MAJCOM A.

Recall from the previous chapter that MAJCOM A is of moderate size with a high civilian-and-contractor-to-military personnel ratio. Within the MAJCOM, leadership tends to rely on business models for decision making. The focus remains on in-garrison operations. In the GeoBase office, a small contingent of civilian personnel provides services for Garrison and Strategic GeoBase. Two contractor personnel, the MAJCOM Garrison and Strategic GeoBase Managers, were interviewed, though the entire staff had an opportunity to review and contribute to the data.

"Decision-making Impetus" and GeoBase as a "Perceived Unfunded Mandate" dominated the responses from MAJCOM A. Stemming from its business culture, the requirement for a strong business case, more than any other factor, drove implementation decisions. Respondents believed the business culture as the decision-making impetus led to further implementation challenges. Lack of a program champion; implementation in smaller, micromanaged increments; and a lack of leadership directiveness or top-down implementation were associated with the business focus of the MAJCOM, negatively impacting the implementation effort. Likewise, the perception of GeoBase as an unfunded mandate was associated with several other reported implementation issues. Although the program is not necessarily mandatory, it represents the future direction of the USAF. Respondents also indicated GeoBase was "too smart" not to do. The lack of planned funding from higher headquarters for the perceived-mandatory implementation tied into all other funding issues in a negative fashion. Furthermore, GeoBase as an unfunded mandate was also related to leadership style (directiveness), change management practices, and the organizational position of the base-level GIO. Stronger leadership directiveness than the MAJCOM's culture created was desired by respondents due to the lack of specific funding. The same lack of funding required a base-level GIO to create wing-wide buy in to fund the GeoBase program. In light of the unfunded nature of the program, informants thought proper change management practices would identify the GeoBase-like activities already in place and the need to redirect the associated personnel or funding to GeoBase.

The histogram in Figure 9 depicts all implementation issues frequently reported by MAJCOM A. On the left, the categories reported as affecting the implementation effort are listed. The length of the bar indicates the number of references to an issue recorded in the MAJCOM data set. The histogram does not reflect the effect, positive or negative, on the implementation effort.

Reported issues at MAJCOM B.

MAJCOM B is large with a low civilian-and-contractor-to-military personnel ratio. As part of the combat air forces, the MAJCOM possesses an operational focus targeting expeditionary activities. The GeoBase office, comprised of a moderately-sized staff, participates in all GeoBase arenas. In addition to the civilian and contractor staff, a

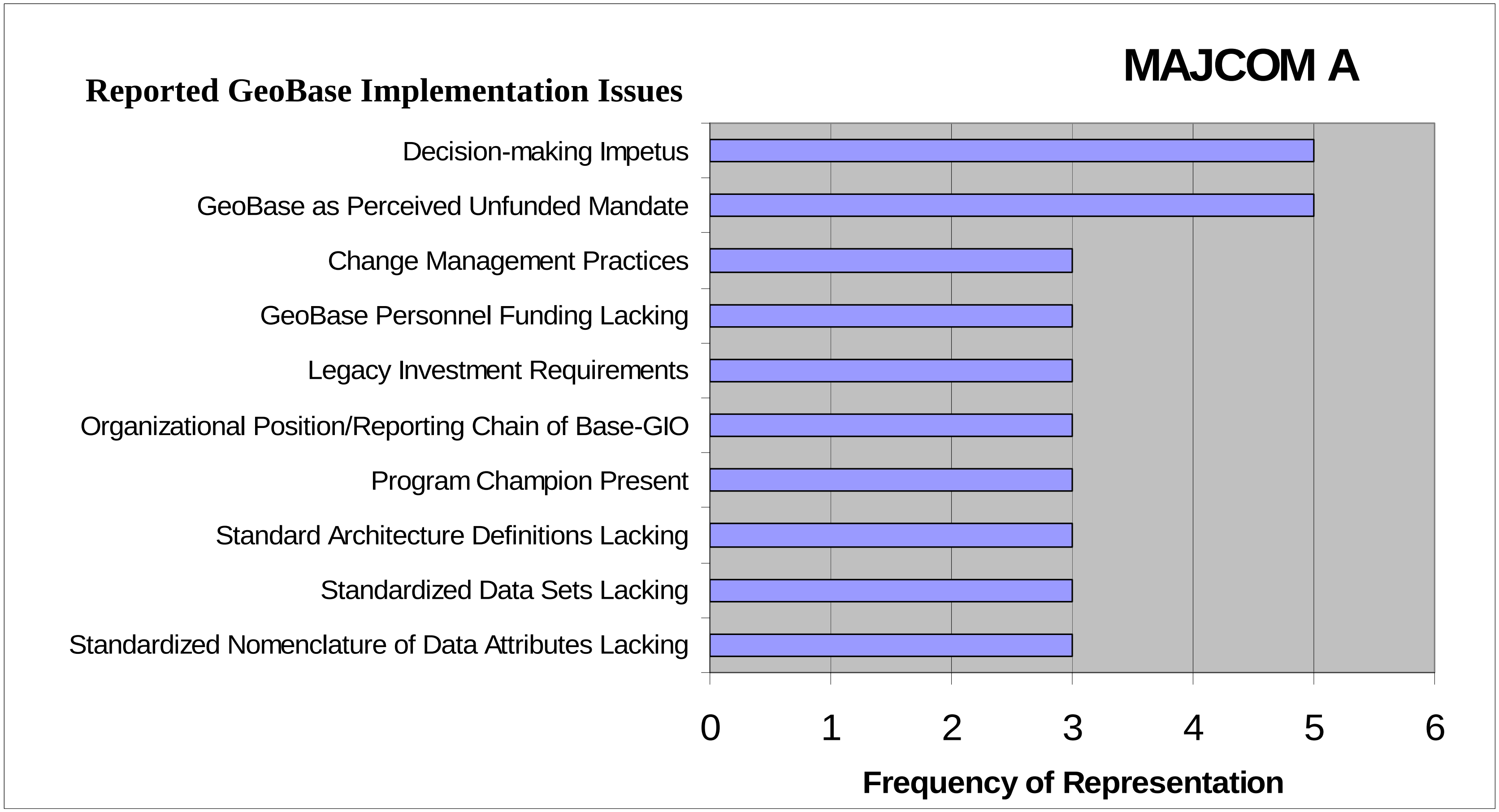

Figure 9. Significant Implementation Issues, MAJCOM A

field grade officer provides oversight for the Garrison, Strategic, and GeoReach programs. All members of the Garrison team were interviewed.

Five issues were reported by MAJCOM B more than any other: unclear funding responsibilities at the MAJCOM level; absence of a centralized, HAF-level effort to accomplish global requirements; coordination with other functional communities; MAJCOM leadership support, style, and personality; and the lack of complete, prescriptive guidance for GeoBase standard data sets. Of these issues, unclear funding responsibilities was reported the most. Problems coordinating the fiscal year 2003 budget provided several instances within the category. According to MAJCOM personnel, HAF requested funding for the MAJCOM-level GeoBase implementations. The level of funding (or percentage of the whole) each MAJCOM could expect was not revealed in a timely fashion. Although GeoBase documents did provide a general prioritization strategy, coordination between the MAJCOM and HAF was insufficient to develop an accurate account of items expected to be unfunded. The lack of HAF-funding insight at the MAJCOM increased the difficulty of competing for other sources of capital. Furthermore, the MAJCOM reported that the definition of the financial code for the program element lacked rigor. The unclear program element code could further complicate the budgeting process when coupled with the funding visibility issue. Although not reported as often as funding responsibilities, the other issues in the top five warrant further discussion.

The absence of a centralized effort at the HAF level to accomplish global requirements primarily refers to two issues: the development of a framework for a certificate to operate (CtO) and an USAF-wide GeoBase training program for personnel directly associated with the implementation, operation, and sustainment of GeoBase. Coupled tightly to coordinating with functional communities, a framework for a CtO refers to the MAJCOM's effort to obtain permission from the C&I community to implement the GeoBase technical solution (the GIS). The C&I community required every MAJCOM and each base or implementation site to obtain a separate CtO prior to activating the GIS. However, the GeoBase program defies current C&I categorization for the CtO process. C&I leadership changes and subsequent reinterpretation of the CtO guidance exacerbated the situation. As such, the MAJCOM perceived great value in the HAF-GIO paving the way. HAF coordination with the HAF-level C&I function and development of better CtO guidance pertaining to GeoBase (and similar systems in the future) could have streamlined the CtO and implementation processes and prevented redundant future efforts. In much the same way, MAJCOM B believes a centralized, USAF-wide training plan for GeoBase implementation and operation would significantly reduce resource expenditures caused by duplication of effort within each MAJCOM. MAJCOMs could augment the training plan if MAJCOM-specific missions dictated a specific need.

Coordination issues with other functional agencies were not limited to the C&I community. Although the CtO process surfaced more than other examples, coordination with any outside agency can be difficult. Any exchange of information and accomplishment of tasks required by or dependent on agencies outside the GeoBase office represent prime coordination issues. Differences in functional priorities and culture continue to create challenges. In fact, functional-cultural differences (including, but not limited to the security forces, medical, C&I, and CE communities) were reported as a concern. Language, view of technology solutions, and operational focus represent functional-cultural differences reported. Change management practices also relate to functional coordination. Primarily, the MAJCOM-GIO was challenged to create a change message relating the reality that any "new GeoBase" activities were already being accomplished. Any need for change was limited to how the mapping activities (collection, storage, access, etc.) would occur. The GeoBase process attempts to change existing processes, which requires coordination of budget, roles, and responsibilities across all functional areas affected by GeoBase. All difficulties with the different aspects of coordinating with functional communities negatively affect the implementation process.

The "Leadership (Support, Style, Personality)" category captures several aspects of the reporting organization's top management personnel. As indicated, the category relates HAF and MAJCOM leadership behavior with respect to being a program champion (support), directiveness (style), and the level of hands-on involvement (personality). Informants reported their leadership adhered to HAF-GIO's management concept of federalism. Although leadership provides strong support with several program champions, they do not micromanage the program. Furthermore, the MAJCOM uses policy memos to provide its vision and direction instead of hard-and-fast guidance. The MAJCOM also prevents promulgation of the unfunded mandate perception by not using

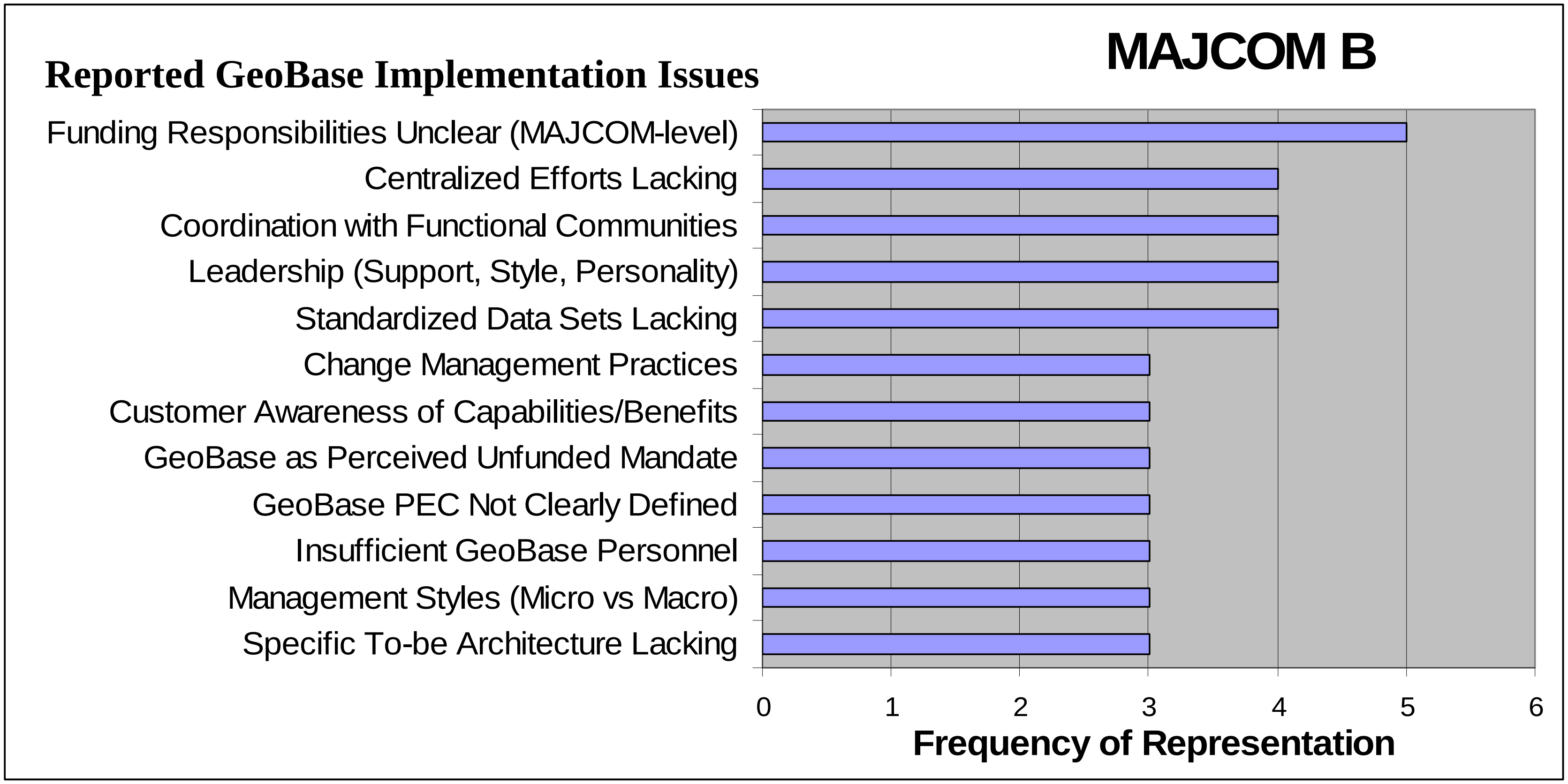

Figure 10. Significant Implementation Issues, MAJCOM B

directives. The strong support, hands-off leadership, and guidance over directives were reported to positively influence the implementation process.

The lack of complete, prescriptive guidance for a standard data set (SDS) to complete the common installation picture, including the standard attributes and metadata, ends the list of significant issues reported at MAJCOM B. The inadequate SDS allowed too much room for interpretation. The variance caused by different interpretations of the SDS led to inaccuracies in the data and data sharing issues between the MAJCOM's implementation sites and among other MAJCOMs. To help alleviate the issues, MAJCOM B published its own more stringent guidance. The guidance does not necessarily address data issues outside the MAJCOM.

Figure 10 presents a histogram depicting all implementation issues frequently reported by MAJCOM B. On the left, the categories reported as affecting the implementation effort are listed. The length of the bar indicates the number of references to an issue recorded in the MAJCOM data set. The histogram does not reflect the effect, positive or negative, on the implementation effort.

Reported issues at MAJCOM C.

MAJCOM C is similar to A in both size and budget. Although its focus is also on in-garrison activities, the culture remains more operational in nature. Its personnel also tend to a more average mixture of civilian, contractor, and military employees. The GeoBase office, headed by a company-grade officer, has a small staff working the

Garrison and Strategic programs. Although one individual was unavailable during the site visit, all others were interviewed. The following issues were reported.

The lack of both a specific target systems architecture and a fully specified SDS ranked at the top of the reported issues. Regarding the inadequacies of the to-be architecture guidance, informants feel well-defined guidance provides continuity, proficiency, and efficiencies in program support and training for GeoBase personnel. The MAJCOM-GIO, therefore, recommends a single technical solution, which would strictly define the to-be system architecture. The MAJCOM published its vision of a single, standard technical solution to help guide its bases and reduce implementation issues. The architecture publication also satisfies the MAJCOM cultural desire for top-down directives, which was also reported as highly desired yet unfulfilled by HAF. With respect to the ineffectiveness of the SDS, respondents reported guidance, especially for Strategic GeoBase, was a moving target. Discrepancies in data reporting and reiterations of work necessary to correct the reports and source data surfaced as the prime challenges. Highly related to the inadequate SDS, poor data accuracy and insufficient data definitions were also reported. Poor data definitions led to nonstandard use or population of attributes. The insufficiently prescribed SDS and poor data accuracy and definitions negatively contributed to the implementation process.

Figure 11 presents a histogram depicting all implementation issues frequently reported by MAJCOM C. On the left, the categories reported as affecting the implementation effort are listed. The length of the bar indicates the number of references

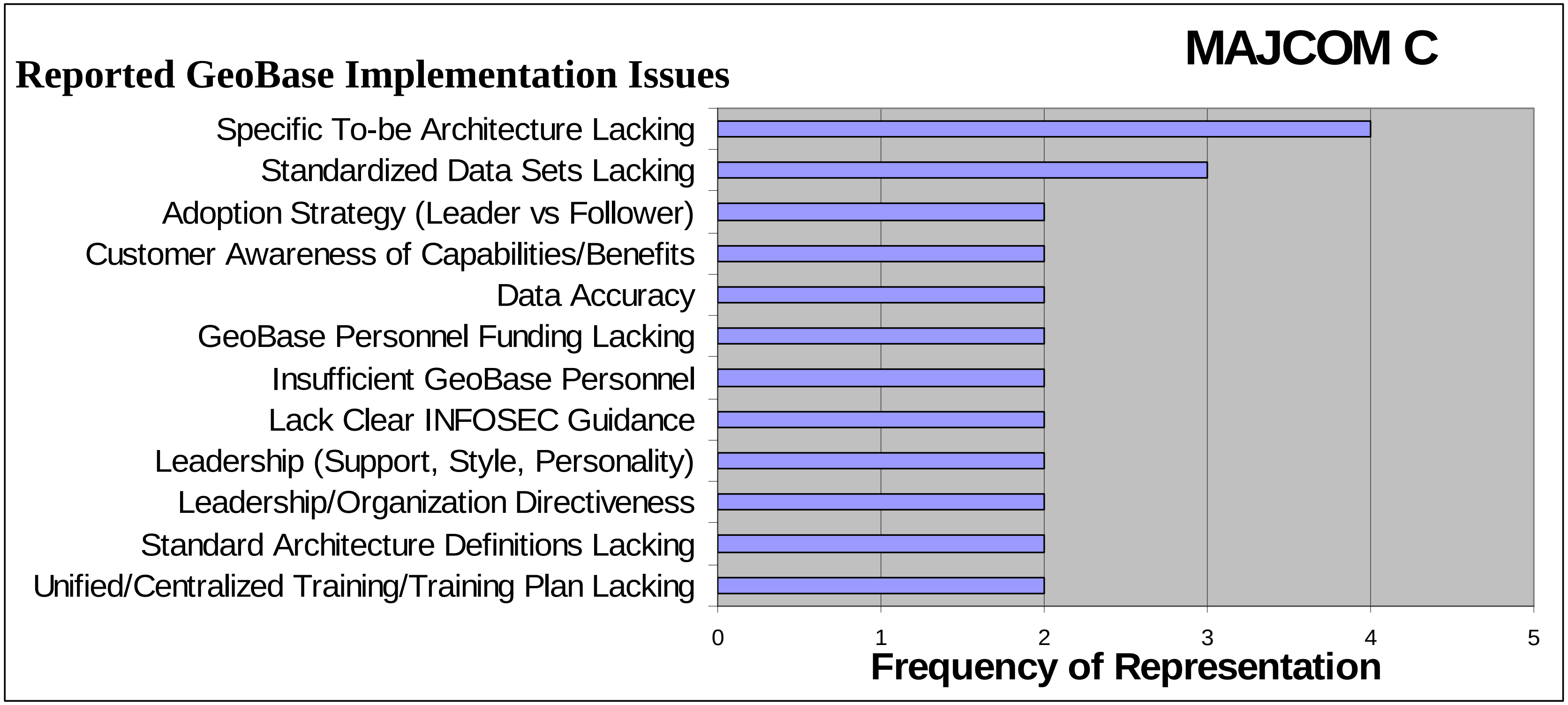

Figure 11. Significant Implementation Issues, MAJCOM C

to an issue recorded in the MAJCOM data set. The histogram does not reflect the effect, positive or negative, on the implementation effort.

Cross-case analysis of reported issues.

It is important to analyze the reported issues across all cases now that each case has been examined individually. In an effort to establish the generalizability of the reported issues, a cross-case analysis provides an opportunity to compare results from the different cases. Issues reported by all three MAJCOMs will first be discussed. Then, select issues reported by two MAJCOMs will be explored. The final analysis will contrast the previous analyses, examining any significant issues reported by a single MAJCOM but not already discussed in this section.

Implementation issues with full concurrence.

Table 9 lists the implementation issues where a consensus between all cases was achieved (full concurrence). Because each challenge was reported by every MAJCOM, these implementation issues are the most generalizable. These issues have the strongest external validity by means of replication. For each implementation issue, a brief expansion of the concept captured by the category will be given. Examples of the reported issue will also be included.

Coordination with functional communities outside GeoBase affected by the program's implementation was discussed above as a significant issue for MAJCOM B. In addition to the MAJCOM B's challenges such as coordinating the CtO, the other

Reported Implementation Issues
Coordination with Functional Communities
Customer Awareness of Capabilities/Benefits
Functional Cultural Differences
GeoBase as Perceived Unfunded Mandate
Insufficient GeoBase Personnel
Leadership (Support, Style, Personality)
Legacy Investment Requirements
Minimum Data Requirements (Completeness) Lacking
Organizational Position/Reporting Chain of Base-GIO
Program Champion Present
Specific To-be Architecture Lacking
Standard Architecture Definitions Lacking
Standardized Data Sets Lacking
Unified/Centralized Training/Training Plan Lacking

Table 9. Implementation Issues with Full Concurrence

MAJCOMs reported coordination of funding, roles, and responsibilities among functional areas as key challenges. Issues related to which functional would pay for and accomplish specific activities (such as data collection and mission data set maintenance) lies at the heart of these other functional coordination obstacles. The difficulties encountered when attempting to resolve issues requiring input from agencies outside GeoBase prolonged the coordination process, negatively impacting the implementation.

GeoBase's target customers lacked an awareness of the capabilities and functionality of the program. A continuing effort to correct the awareness deficiency, all MAJCOMs reported initiatives to educate leadership and functional communities. The education message highlights new or improved capabilities GeoBase brings to the mapping, support, and warfighting communities. Additionally, informants linked awareness education with improving functional coordination and funding. Making GeoBase a priority for all communities would ease the implementation effort. Increased awareness also led to an increased presence of GeoBase champions, positively affecting the implementation, especially at base level.

Respondents recognized other functional communities do not necessarily possess the same culture as do the GeoBase and CE functions. Related to coordination with functional communities, cultural issues ranged from project and funding priorities to the functional view of mapping activities and responsibilities. The way GeoBase related to the functional community's mission and the community's previous project priorities often determined the relative importance of GeoBase within the functional culture. The functional community's view of technology applied to problem solving and the community's acceptance of change in general also contributed to the cultural differences experienced by informants. As such, some of the differences highlighted by these issues were thought to give rise, at least in part, to the functional coordination issues. Challenges stemming from cultural differences hampered the implementation.

Some would argue "money makes the world go 'round". As indicated by the case studies, funding certainly affects many aspects of the GeoBase implementation process. Funding in out years becomes the responsibility of the individual MAJCOMs. Funding supports equipment, personnel, training, data collection, et cetera. Without proper funding the MAJCOMs struggle to accomplish the implementation, though one comment suggested the maintenance phase may be financially more predictable and therefore easier to fund. In the end, the MAJCOMs summed up the base-level sentiments on unfunded mandates as, “no money, no action.”

“Insufficient GeoBase Personnel” denotes the informants’ sentiment that their staffs were too small. In some cases, the informants simply felt overworked. Others reported a recognized need for more personnel but a lack of funding or alternative manpower source. Furthermore, the budding nature of the program was thought to cause manning issues. One MAJCOM was projected to receive new personnel in the next year as funding and leadership support continued to increase. Interestingly, the size of the MAJCOM and its GeoBase missions did not impact the perception of necessary manning levels. The larger MAJCOM had a larger GeoBase staff and more taskings, which matched the apparent workload per employee of the smaller MAJCOMs. The two operational MAJCOMs did appear more heavily tasked by outside agencies than the business-focused MAJCOM A.

“Leadership (Support, Style, Personality)” was referenced more than once in each case study. However, the respondents from different MAJCOMs were not always on the same side of the fence. MAJCOMs A and C diverge to the fullest extent with respect to a directive leadership personality. In MAJCOM A, the prevalent culture demands more autonomy. MAJCOM C personnel expect downward direction. Regarding the style, MAJCOM A reported micromanagement of the implementation steps by its leadership. The other MAJCOMs stated their leadership was more hands off. All MAJCOMs stated hands-off leadership positively influenced implementation, whereas micromanagement hindered it. As for support, all informants agreed a program champion ("senior executive with enough clout" to drive change (Hammer & Champy, 2001, p. 107)) was vital. Although a champion at the highest levels was thought most beneficial, program champions were reported to be important at all levels of implementation. Respondents at each MAJCOM referenced the importance that a program champion's influence has. In fact, the need for a program champion was reported often enough to warrant its own category. Not all MAJCOMs testified to having such support within their command.

Investments in legacy systems must be considered when implementing a new system or program as discussed in the literature review. Although each MAJCOM reported the need to identify legacy mapping and GIS requirements associated with the GeoBase implementation, the need varied at each MAJCOM. MAJCOM B was mainly concerned with system and information architecture standardization for integration and data sharing between the new technology and legacy systems. Steeped in legacy investments stemming from a long history with mapping, MAJCOM A focused on capabilities to manage the varied system architectures in place. MAJCOM C developed a standard solution virtually free of legacy requirements due to a lack of GIS history. Consideration of legacy investments most often extended the MAJCOMs implementation timeline, requiring a longer transition period between architectures. The lack of legacy requirements at MAJCOM C was a definite boon to implementation.

Each case location identified the lack of a standard, minimum baseline for data collection and input. Although reported with various degrees of specificity, all informants stated a minimum standard for a complete data set did not exist. Current guidance for the minimum required data was deemed woefully inadequate. The greatest challenge occurred in data sharing. When MAJCOMs attempted to compile data (on wetland areas for instance) from their various bases or share with other MAJCOMs the data sets were not always populated identically (e.g., how many and which attributes were entered). The variance was sometimes quite large, rendering the intended goal to compile the data impossible without significant changes to the data sets. The difficulties aligning implementation sites data population efforts negatively influenced implementation.

The position of the base-level GIO and the associated reporting chain of command may not be the highest priority implementation issues facing MAJCOMs. Planning ahead however, each MAJCOM reported issues related to finding the best position in the organizational structure for the GIO. MAJCOM A noted the position is still in the works, first requiring increased leadership buy-in. GIOs with a better understanding of the GeoBase, CE, and installation community's needs will also be required. At MAJCOM B bases, the GIO started as an element within a flight. Further development of the position rests with each installation. Although still unsure where the bodies or funding will come from, MAJCOM C has published a base-level GIO roadmap, which specifies current minimum organizational requirements for the position within CE. It also provides a clear vision for the future with a Major as the GIO under the Mission Support Group. Despite the positive effect a strong base-level GIO had as a change agent for GeoBase, MAJCOMs reported it one was not necessary at this time. GIOs with insufficient skills or knowledge of the GeoBase program hurt the implementation effort.

Respondents testified that the lack of a specific to-be architecture causes various issues. For instance, MAJCOM A has found it difficult to develop a clear migration strategy from the legacy systems it currently employs. Any plan has a weak business case due to the lack of a firm future architecture. MAJCOM B's implementation has also been delayed. Due to these stumbling blocks encountered by other MAJCOMs (such as MAJCOM A and B), the lack of a specific to-be architecture contributed to MAJCOM C adopting a fast-follower mentality. Respondents indicated lessons learned from other MAJCOMs were incorporated into the single architecture vision published by MAJCOM C. Though MAJCOM C has implemented slower than other MAJCOMs, informants reported getting it right the first time. The lack of a specific to-be architecture has still been a detriment to the implementation.

The lack of a SDS, discussed within the significant issues from MAJCOMs B and C, represents a broad category that also encompasses the inadequate data definitions and the lack of minimum standards (discussed above in this section). With regard to data definitions, GeoBase personnel must know what each attribute means and how it should be populated. Guidance was described as a moving target. MAJCOM B felt it could not wait for a HAF solution and published its own guidance, clearing up many problems within the MAJCOM but not across MAJCOMs. Although the HAF was reported to have plans for improved guidance, informants are concerned it may not match current implementation. Respondents indicated frequent changes in direction would ruin the program's credibility should they occur (this has not been an issue yet). Frequently mentioned at MAJCOM A, personnel stated poor data definitions and the inadequate

SDS led to ineffective, inaccurate reports (e.g. submission of the entire data set required for Strategic GeoBase). Personnel expended great effort to rectify the inaccuracies. A thorough standard is clearly necessary.

The final issue with consensus, lack of a unified or centralized GeoBase training function or plan, again reflects the HAF's federalist perspective of the GeoBase program. Although the HAF expects each MAJCOM to generate its own GeoBase training plan, the MAJCOMs reported a lack of training resources in general. They also indicated the creation of MAJCOM-specific training programs from scratch would waste resource by duplication of effort in the creation, implementation, and maintenance of the training and increase the retraining requirements for troops rotating between MAJCOMs. The CE school house has recently developed a training program for engineering assistants (the primary operators of GeoBase in the CE function), which indicates the start of a centralized training effort.

Significant implementation issues with partial concurrence.

Implementation issues with partial concurrence (reported at two of the three sites) may still be generalizable to the GeoBase program as a whole. Although complete replication did not occur, the reasons may be explainable. A MAJCOM without a clear distinction between its garrison and deployable operations, as is the case for MAJCOM C would not report garrison or expeditionary focus as an issue (as would the other MAJCOMs representing opposite ends of the spectrum) for example. Therefore, the most significant findings that have not been previously discussed will be explored now.

Several issues related to the specifics of the MAJCOM implementation efforts will be held over until the following section. Table 10 lists the issues with partial concurrence.

Reported Implementation Issues
Change Management Practices
Data Accuracy
Decision-making Impetus
Focus (Garrison vs Deployed)
Funding Responsibilities Unclear (MAJCOM-level)
GeoBase Personnel Funding Lacking
Guidance Not Clear (Moving Target)
Hiring Pool Lacks Experts
History with Mapping/GIS
Key Players Not Under Same Chain of Command
Lack Clear INFOSEC Guidance
Leadership/Organization Directiveness
Management Styles (Micro vs Macro)
Military, Civilian, and Contractor Stereotypes
Multiple Technical Solutions
No Money, No Action
Number of GeoBase Programs Managed
Poor Personnel Continuity
Training/Training Plan Not Current Priority

Table 10. Implementation Issues with Partial Concurrence

Both MAJCOMs A and B reported issues related to change management. Basically, the respondents think of GeoBase not as something entirely new. They identify GeoBase as a new way of conducting old business. In this regard, they believe a key for implementation lies in change management. Leadership and functional experts must be convinced of the need to change. Because MAJCOM C had an extremely limited legacy in automapping, it did not share the same perspective as the other two cases. The capabilities of GeoBase must still be "sold" to an extent that causes other functionals to champion the program.

Although future funding requirements will be the responsibility of the MAJCOMs, the past and current funding responsibilities were reported to be unclear. Already discussed in the analysis of MAJCOM B, respondents from MAJCOM A also reported similar issues. A lack of clear funding intent from HAF greatly increased budgeting difficulty and severely hampered efforts to lobby for funds from other sources. Again, the weening of MAJCOMs from HAF funding should eradicate the issues. This is apparent at MAJCOM C where the follower strategy employed allowed funding issues to sort out before they became an issue for the MAJCOM.

Information security (INFOSEC) "raises the hairs on the back of many necks." Without clear guidance regarding INFOSEC with respect to GeoBase, leadership in MAJCOMs B and C remains wary. Both MAJCOMs still recommend serving the information from the non-secure internet protocol router network and relying on network security protocols to protect the information. MAJCOM C was quick to point out the widespread availability of much of the information already from less well protected alternate sources (i.e., the public affairs office, base phone book, etc.). Still, clear GeoBase INFOSEC guidance was requested and is required.

Not having all the key players working in the same office created coordination issues at the lowest levels within the MAJCOM GeoBase offices. Occurring in both MAJCOMs A and B, implementation continues to be hampered due to separate chains of command for key personnel working on different GeoBase components. Task and funding responsibilities were reported as the top issues resulting from the separation. The GIO at MAJCOM B actually has responsibility for a portion of GeoBase personnel and their mission without any associated authority (these personnel fall within another segment of the organization).

Focus, decision-making impetus, and the leadership subcategories fall under the more general heading of culture. At MAJCOMs A and B, the organization's focus played a significant role in implementation. A focus on garrison operations tended to facilitate implementation progress. Other the other hand, an expeditionary focus led to a prioritization of other programs, including those in the GeoBase family (e.g. GeoReach). The mixed focus at MAJCOM C may have quelled this issue. Similarly, the impetus for decision making spurred the implementation if operationally focused and hindered it if stemming from business practices. Micromanagement accompanied the business practices at MAJCOM A and further slowed implementation. The hands-off leadership style in MAJCOM B benefited the implementation process. Finally, directive leadership was the order of the day at MAJCOM C and drove implementation. MAJCOM A reported downward direction to be against its cultural values, but clearly a benefit to implementation. MAJCOM B avoided directives, but was still able to establish a clear vision for the bases. A solid middle ground seem to be achieved by MAJCOM B's actions. The best cultural mix for rapid, smooth implementation of GeoBase should include an in-garrison focus; an operational decision-making impetus; hands-off, and directive leadership.

Significant MAJCOM-specific implementation issues.

Certain implementation issues reported at a single MAJCOM may be significant for two main reasons. As discussed in the individual analysis of the MAJCOMs, a single issue may have occurred numerous times. Such an issue could be significant outside the MAJCOM and is certainly important to the MAJCOM itself. These issues could stem from a theoretically replicable situation such as the long history of mapping present at only one MAJCOM. In addition, certain issues only reported by one MAJCOM may provide insight into the nature of GeoBase implementation in the specific environment represented by the MAJCOM. Similar environments may experience similar implementation issues even if none of the other cases in this study reported them (since cases were purposely chosen to have overlapping, but not identical implementation environments). This possibility of similar issues resulting in similar environments also stems from theoretical replication as discussed in the methodology.

The following paragraphs will examine each MAJCOM-specific issue of significance. Unlike the opening analysis, this exploration will consider the MAJCOM's responses with respect to the other MAJCOMs and their characteristics. A composition matrix describing the MAJCOMs' similarities and differences can be found in Chapter 2 (Table 6). A complete list of reported implementation issues can be found in Appendix G.

Implementation issues specific to MAJCOM A.

MAJCOM A reported two interesting areas with greater detail than other MAJCOMs: training and information architecture. With respect to training, MAJCOM A indicated its personnel were subject to a higher GeoBase-related retraining requirement and beginner bases had a steep learning curve. Both challenges stem from the MAJCOM's long history with mapping, including the use of technology for automated mapping functions. As personnel rotate in and out of the organization, the multiple technological solutions encountered at different sites increase the retraining need. Beginner bases face the same challenge as they attempt to catch up with the bases rich with a history in automated mapping.

MAJCOM A also reported issues concerning the information architecture not reported at other sites. Basically, the undefined process for the collection and maintenance of data and information created problems. The lack of a clear delineation of responsibilities between the functional data stewards and the GIO concerning who should collect the data and maintain it, as well as fund these processes caused much debate. Furthermore, clear guidance stating data-refresh requirements compounded the issue. The MAJCOM-GIO could not answer the question, "When is data out of date?" Again, the causes may be the long history of data collection and maintenance within the MAJCOM. Attempts to change the processes with the introduction of GeoBase have therefore encountered more entrenched practices than at other MAJCOMs.

These issues may not be isolated to MAJCOM A. Certainly, the data challenges represent a subset of the information architecture guidance issues reported for each case study. Data refresh rates definitely have an effect outside the MAJCOM (e.g. Strategic GeoBase reports to HAF). However, the training issues may be isolated to MAJCOMs or bases fitting the profile of MAJCOM A. The long history with automated mapping at some bases created a wide spectrum of implementation stages and technology solutions within MAJCOM A. The diversity contributes to the accelerated learning curve required by personnel or installations new to GIS and automated mapping.

Implementation issues specific to MAJCOM B.

Two issues recorded solely at MAJCOM B warrant further discussion: the number of sites implementing GeoBase and data sharing across the firewall. Although somewhat obvious, the number of sites attempting implementation significantly contributes to the challenge of the overall effort. The number of sites affected implementation in a non-linear manner. However, staff size increased relatively linearly compared to the smaller MAJCOMs. Beyond the simple complication of more sites, the increased number of locations boosts conflict. Many sites presented good ideas; selecting a single one as the vision created strife. Furthermore, the pace of implementation at installations and the number of unique issues also contributed. The large number of bases increased the spectrum of implementation speeds, quality, etc., stretching the MAJCOM staff. Other large MAJCOMs should take note and perhaps learn. Speaking of learning, data sharing across the firewall piques interest due to the apparent lack of learning. Why does only one MAJCOM report such a problem when all MAJCOMs possess a similar network architecture (albeit far from standardized) imposed by the C&I

community who owns the network infrastructure? Although the HAF-GIO hosts an annual conference, communication among the MAJCOMs outside this forum appeared limited. How are lessons learned communicated? To be fair, MAJCOM B tends to be the front runner in the implementation process and may have been the first to encounter the issue. Other leading-edge MAJCOMs should be aware of this possible snag and other as of yet unencountered issues.

Implementation issues specific to MAJCOM C.

MAJCOM C adopted a fast-follower implementation strategy, enabling it learn from many of the other MAJCOMs. As such, MAJCOM C's identification of the dependencies inherent to specific technology solutions stands out. Informants stated certain technology solutions carry with it related challenges. For instance, respondents indicated Oracle-based architectures dictate an expertise not well established in either the military or civilian sectors. MAJCOM C also advocates a single-solution vision while providing competition and creativity independent of platform.

Reported Implementation Issues Compared to GeoBase Sustainment Model

The next step in the analysis involves a comparison of the implementation issues reported in the case studies to those represented by the GSM (Figure 12) and answers the second research question. Now that the reported issues have been explored, it is important to determine how well the current GSM reflects these issues. Recall that the

GSM was originally developed through anecdotal evidence. A comparison of the model to the reported issues takes the first step toward a validated model.

Appendix H contains all reported implementation issues categorized per the GSM. Where issues did not clearly fit into an existing construct of the GSM, an "Other" category was created. Issues classified under the "Other" category have also been subcategorized (Leadership, Scope of GeoBase Involvement, and Communication).

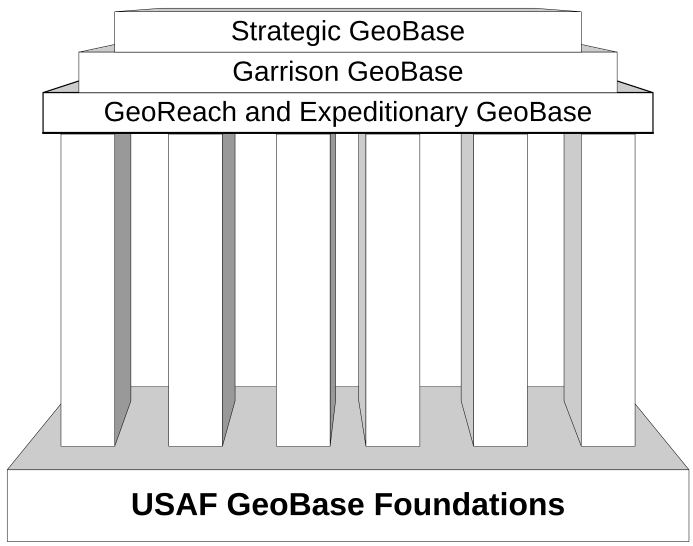

Figure 12. Current GeoBase Sustainment Model (adapted from Cullis, 2003c)

The GSM represents its concepts in six pillars (Systems Architecture, Financial Management, Policy and Guidance, Education and Training, People and Workflow, and Information Architecture) and the USAF GeoBase Foundations (representing "Planning" and "Culture"). After analyzing the interview data, all GSM concepts were determined to be represented in the reported implementation issues. In fact, several subcategories of implementation issues were identified for each GSM concept. Every GSM concept, except Policy and Guidance, also possesses at least one subcategory with full concurrence across all MAJCOMs. However, “Planning”, a concept represented by the foundation, was only reflected by only two related issues (lack of a training plan and the low priority to develop one) reported in the case study. At this stage of the implementation, low representation for planning by the reported implementation issues is reasonable. The bulk of planning should have ceased by this time in the implementation phase (Schwalbe, 2004).

The reported implementation issues represent all the constructs of the GSM. However, the GSM does not represent all of the reported implementation issues and is, therefore, adequate but underspecified. Before suggesting changes to the model, the key dimensions of IRM will be examined and compared to the GSM. The HAF-GIO purports the model represents IRM as well as GeoBase implementation issues. A more complete critique of the model’s representation of both the current implementation issues and key IRM dimensions will then be made.

Key Dimensions of Information Resource Management

Before evaluating the GSM for IRM content, the key dimensions of IRM had to be established as indicated by the third research question. Recall from the literature review that a singularly-accepted, comprehensive IRM definition does not exist. In this section, the content analysis of IRM and CIO literature (Benjamin et al., 1985; Davies, 1987; Feeny & Willcocks, 1998; Guimaraes, 1988; Lewis et al., 1995; Lytle, 1988; O'Brien & Morgan, 1991; Owen, 1989; Stephens et al., 1992; Trauth, 1989), CIO legislation and documentation (44USC3506, ; "Clinger-Cohen Act of 1996,"; Golas, Lisagor, & Parham, 2001; Office of Management and Budget, 2000), and AF strategies (DAF, 2002b; DAF: CIO, 2000) will be presented. The content analysis extends the work of Lewis, Snyder, and Rainer (1995), setting a solid foundation to compare IRM to the GSM.

The content analysis confirmed the work of Lewis, Snyder, and Rainer (1995) and justified its use with respect to this research. To begin, all of the major categories of IRM dimensions specified by Lewis et al. are represented by the literature and documentation included in the content analysis. The USAF Information Strategy (DoAF, 2002b), in particular, referenced each major category. Figure 13 presents the results of the content analysis with respect to the major categories of IRM dimensions. In the figure, the major dimensions of IRM are listed as are the analyzed content's sources. A checkmark indicates the respective dimension was referred to in the particular source document.

The GSM is not necessarily an IRM model. Therefore, a more thorough content analysis of IRM dimensions was accomplished. The more defined, near-task level categories for IRM dimensions presented by Lewis, Snyder, and Rainer (1995) provided a more complete and exacting basis for a comparison of the GSM with IRM (see Appendix I). However, the IRM content analysis did give cause to drop three dimensions from the set proposed by Lewis et al. CIO approval of corporate-wide IT acquisitions, user support for distributed IT facilities, and the use of automated development tools were poorly supported by the IRM and CIO literature reviewed (see Appendix I). The latter two categories were not reported in any documents included in the content analysis other than

IRM Dimensional Categories	**IRM Literature from Academia**								**CIO Literature and Federal Documents**							
	Lewis et al (1995)	Davies (1987)	Lytle (1988)	Owen (1989)	Trauth (1989)	O'Brien and Morgan (1991)	Feeny and Willcocks (1998)	Guimaraes (1988)	Clinger-Cohen Act (1996)	44USC3506	OMB A-130 No. 4 (2000)	AF-CIO Focus Areas	AFFIRM Survey (2001)	AF Information Strategy (2002)	Benjamin et al (1985)	Stephens et al (1992)
Chief Information Officer	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
Planning	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
Security	✓	✓		✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	
Technology Integration	✓	✓	✓	✓	✓	✓	✓	✓					✓	✓	✓	✓
Advisory Committees	✓			✓		✓						✓		✓		
Enterprise Model	✓	✓	✓	✓	✓	✓					✓		✓	✓	✓	✓
Information Integration	✓	✓	✓	✓	✓						✓		✓	✓		✓
Data Administration	✓	✓	✓		✓	✓		✓		✓	✓		✓	✓	✓	✓

Figure 13. IRM Content Analysis Results

the article by Lewis et al. Perhaps more importantly, none of the federal documentation examined referenced these three dimensions. The CCA (1996), concurring with Feeny and Willcocks (1998), even contradicted the notion of the CIO as the corporate-wide IT acquisition approval authority. Although the reader may identify several other minor dimensions in Appendix I as sparsely referenced, these dimensions were not eliminated. Sufficient support for these dimensions, especially by the Federal documents, demonstrates relevance to this research. The categories for IRM dimensions presented by Lewis, Snyder, and Rainer (1995) did not capture all the factors involved in IRM as determined by the content analysis performed by the researcher. After a thorough examination of the literature, two additional major categories were considered: knowledge management (KM) and education and training. These concepts were referenced by a majority of the literature articles and Federal documents. However, the researcher considers KM as a separate discipline from IRM and did not include it as an additional key IRM dimension with respect to this research. Education and training was considered separately.

Education and training required more consideration than KM. During the content analysis, user training, education and training of IRM personnel, and leadership education were identified as subcategories to the major IRM dimension of education and training. Lewis et al, however, include only user training as an IRM dimension (listed under the major category of planning). Given the number of references to the education and training of IRM personnel and leadership education, Lewis et al did not fully specify training in their set of IRM dimensions. Education and training must be include as a major IRM dimensions with the subcategories of user training, education and training of IRM personnel, and leadership education to fully represent the contingent of IRM documents (especially in the Federal perspective). Note, education and training in general and specifically leadership and IRM personnel education and personnel training may be more correctly associated with disciplines other than IRM (e.g. human resource or general management). Their presence in the literature and documents included in the content analysis still validates their inclusion in a discussion of key IRM dimensions in this research setting.

Information Resource Management Dimensions and the GeoBase Sustainment Model

A comparison of the identified key IRM dimensions to the GSM reveals the validity of the HAF-GIO assertion that the model and the GeoBase implementation and sustainment approach represents IRM principles. As stated earlier, the GSM is not primarily an IRM model. A multi-level examination of the model was therefore conducted. First, a more general exploration of the GSM was conducted. The major categories of the key IRM dimensions were used for this first-order analysis. Then, a more in-depth examination was conducted. The complete set of key IRM dimensions relevant to this research were mapped against the concepts represented in the GSM.

General comparison of IRM and the GSM.

The first-order analysis of the GSM with respect to the major IRM dimensions indicates the model more than adequately represents the key dimensions. As indicated in

Table 11, all the major IRM dimensional categories except the use of advisory committees map to a concept presented in the major components of the GSM. Use of advisory committees did not present at all during the analysis. Additionally, information integration correlated weakly to the Policy and Guidance pillar in the qualitative analysis. The GeoBase Mission Statement, though not an explicit part of the model, presents a strong message for information integration and is considered part of the Policy and Guidance. Although a strong model, the GSM is underspecified with respect to the key dimensions of IRM. The detailed analysis will expand upon this assertion.

Major Categories of Key IRM Dimensions	**Matching GSM Concepts**
Chief Information Officer: Roles and Responsibilities	GeoBase Information Officer (People and Workflow) Federal Mandates (System Architecture)
Planning	Planning (Foundation)
Security	INFOSEC (Information and System Architecture)
Technology Integration	System Architecture
Advisory Committees	N/A
Enterprise Model	Enterprise Approach (Policy and Guidance)
Information Integration	Mission Statement (Policy and Guidance)
Data Administration	Information Architecture
Education and Training	Education and Training

Table 11. General Comparison of IRM and GSM

Detailed comparison of IRM and the GSM.

A more exhaustive comparison of the GSM to the entire set of key IRM dimensions further verified the validity of the HAF-GIO's supposition that the model and GeoBase execution thoroughly addresses IRM. Using the content analysis results for the key IRM dimensions and GSM concept categories, matching pairs from each set were identified (see Appendix J). Twenty-seven of the 46 GSM concepts mapped to 30 of the

47 IRM dimensions. As such, the GSM represented the key dimensions of IRM more completely than 50 percent of the IRM literature included in this study. The thoroughness of the GSM deserves recognition, especially in light of the exclusion of literature without robust IRM definitions before the content analysis. However, the model remains underspecified. The following paragraphs will discuss significant IRM dimensions and GSM concepts that were both matched and not.

The GSM represents all major IRM dimensions except the use of advisory committees as previously stated. Furthermore, all highly represented dimensions (indicated by more 65 percent of the documents reviewed), except the CIO's participation in corporate business planning, were matched. Highly represented dimensions explicitly matched include planning for corporate-wide IS and technology (IS&T), assessing new technology, possessing standards for distributed IT. Not an explicit match, the last highly represented dimension is ensuring the IS&T plan reflects business goals. The GeoBase goal to provide the warfighter an improved decision making capability in the operational environment clearly addresses an USAF business need. Finally, it is worth noting the GSM does include multiple references to acquisition and includes IT portfolio management as a concept. The inclusion of acquisition and IT portfolio management gains significance due to the strong emphasis on these concepts in the CCA (the principle, governing federal mandate).

Fifteen minor IRM dimensions remained unmatched in the GSM. However, six of these unmatched dimensions were poorly represented in the IRM content analysis (dimensions were represented in no more than four documents) and hold little significance. Additionally, data integration between applications and communications, network, and application systems integration were not matched. These four dimensions do not fully apply to the GeoBase program, but are more properly the responsibility of the owner of the network (AF-CIO). The GeoBase system and information architectures indicate an integrative design as part of an overall system as should programs following the IRM direction of the network owner. Three unmatched dimensions fall under the major category calling for the use of advisory committees. Recall, the first-order analysis identified the major deficiency of the GSM not representing the use of advisory committees. MAJCOMs, though, already reported the use of advisory committees by way of the current function of base-level GIOs. GeoBase leaders also participate in configuration control boards at their various level. Although not represented in the GSM, use of advisory committees is incorporated, at least in part, in the GeoBase program as a whole. The remaining two unmatched IRM dimensions warrant further discussion.

Use of a formal methodology for systems development appeared in a moderate proportion of the literature and documents analyzed. However, the GSM did not reflect this key IRM dimensions. GeoBase policy and guidance along with the system and information architecture may direct system development. Unfortunately, these documents do not lead to a repeatable methodology for system development as is the intent captured in the literature. The formal methodology may therefore more rightly fall under the purview of network owner. A formal methodology for application development and products specific to GeoBase should still be followed and perhaps represented in the GSM.

The GSM fails to include one highly significant IRM dimension, CIO involvement in corporate business planning. Because a CIO exists at the MAJCOM and HAF levels, it should not be necessary for the GIO to be directly involved in the corporate-level business planning. The GIO should engage in planning more corporate in nature than solely GeoBase-centric activities. As mentioned previously, the extent to which the GIO is involved with higher planning is not represented in the model. GIO involvement in higher-level planning captures the intent of the key IRM dimension.

The analysis of the GSM with respect to key IRM dimensions supports the HAF-GIO assertion that the model expresses IRM in the GeoBase environment. However, the model failed to capture all the key dimensions included in the full set of IRM. Proposed changes will be withheld until the final analysis of the GSM is conducted in the next section.

Federal Information Resource Management and the GeoBase Sustainment Model

Programs within the Federal Government must abide by legislation that does not dictate the actions of the private sector. Therefore, a detailed examination of the GSM with respect to only Federal IRM documentation assumes greater importance in the USAF environment. Such an analysis demonstrates the extent to which the GSM addresses key dimension of IRM as specified by Federal documentation, including the focus areas of the AF-CIO.

Content analysis of only the Federal documentation eliminated four dimensions from the previous IRM set. Because they were not represented by the Federal documents in the content analysis, inclusion of centralized, distributed and desktop domains in IS&T planning; planning processes including end users; formal support for end users; and presence of office automation capabilities are not key IRM dimensions from a solely Federal Government perspective. Global acquisition control, however, emerged as more relevant in the Federal IRM arena and was added to the set of key Federal IRM dimensions. Unlike the academic literature which place global acquisition control with the CIO, Federal documents vested the controlling authority for IS&T acquisition with each agency director. Table 12 summarizes changes to the set of key IRM dimensions for the Federal analysis.

Action	IRM Dimension
Delete:	IS/T Plan Incorporates Central, Distributed and Desktop Domains
Delete:	Planning Process for IS&T Incorporates End Users
Delete:	Formal Support for End-user Computing
Delete:	Office Automation Capabilities
Add:	Global Acquisition Control

Table 12. Changes to Key IRM Dimensions for Federal-Perspective Analysis of GSM

An analysis of the GSM based on the revised set of key IRM dimensions for a Federal Government perspective returned improved results compared to the original analysis using the full set of key IRM dimensions. With the addition of global acquisition control as a key IRM dimension, a new match occurs. The GSM indicates acquisition control in both the Systems Architecture and Financial Management pillars. Additionally, the removal of IS&T planning across all domains and formal support for end-user computing as key dimensions improved the GSM's representation of IRM from a Federal perspective. Twenty-nine of the 46 GSM concepts mapped to 29 of the 44 major and minor IRM dimensional categories. As such, the GSM adheres to the requirements of Federal IRM documentation. The GSM captures many tenets of the CCA (1996), AF Information Strategy (DoAF, 2002b), and the AF-CIO Foci (2000), in particular.

The GSM near-fully represents the major dimensions of IRM. Moreover, the GSM more than adequately captures a more detailed picture of key IRM dimensions. The effectiveness of the model to represent IRM from a Federal perspective was shown to be even better. Furthermore, the GSM represents all general implementation categories reported. Most of the more comprehensive categories were likewise indicated. However, changes to the model may further increase its effectiveness in representing current implementation issues and key IRM dimensions. Suggested changes will be discussed next.

Changes Indicated for the GeoBase Sustainment Model

The analyses of the GSM presented above qualitatively validate the proposition that the model and the GeoBase implementation and execution strategy adequately represent both GeoBase implementation issues reported and key IRM dimensions. However, the analyses also indicate several changes to the GSM to improve its representation of the implementation issues and IRM. The following paragraphs discuss these recommended changes. Figure 14 depicts the proposed revisions to the current GSM.

The most difficult step in performing the analyses in this research involved the content analysis of the GSM itself. Although some documentation exists expressing the intent of the GSM and the represented implementation strategy, the model does not have a clearly articulated definition. Source documents detailing the exact nature of the concepts the GSM intends to represent should be constructed. The following changes should be incorporated into that document.

Informants expressed communication issues played a key role in implementation. However, the GSM does not explicitly reference communication. Inclusion of communication in the framework may also capture the change management principles and augment the culture reference contained in the foundation. Communication should represent both vertical communication within the program and the necessary communication across functional boundaries. Of course, proper communication is not unidirectional. The full-duplex nature of communication should be addressed in the model, as well.

Analysis of the GSM with respect to the reported implementation issues also revealed two other areas reported but not expressed in the model. First, leadership aspects represent a group of issues not fully expressed in the model. Leadership includes the presence (or absence) of a program champion, leadership style (directiveness), and leadership personality (micro- versus macro-management). Secondly, the scope of the implementation constitutes an important factor not accounted for in the model. Scope describes the size of the implementation project, including the number of implementaiton sites. However, these categories may best be represented in existing elements of the model such as the USAF GeoBase Foundations. Leadership and scope may be aspects of culture and planning, respectively, which the foundation already models.

Federal, business, and academic documentation indicate the importance of advisory committees. Currently, the GSM does not represent the use of advisory committees or any of its subcategories at any implementation level within the GeoBase implementation and execution strategy. A revised GSM should include reference to the use of advisory committees. Current advisory committees in the area of GeoBase include configuration control boards; technical architecture steering groups; and command, control, communications, and information working groups.

An unintended result of the research qualitatively identified interdependency between the concepts of the GSM. For instance, respondents indicated issues related to personnel or the lack thereof. They also indicated funding created some of the personnel issues. Policy was then cited as a driver of financial management practices. Therefore, an indication of this interdependency should be included in the model if possible. A hierarchy in the pillars may be discovered and facilitate the representation of the dependency indicated by this research.

Summary of Results

This research examined the current GeoBase implementation issues facing MAJCOMs in the USAF and the IRM dimensions key to the environment of GeoBase. Regarding implementation issues, a solid data set was collected and analyzed. Reported implementation issues reflected predictions based on literature and documentation cited

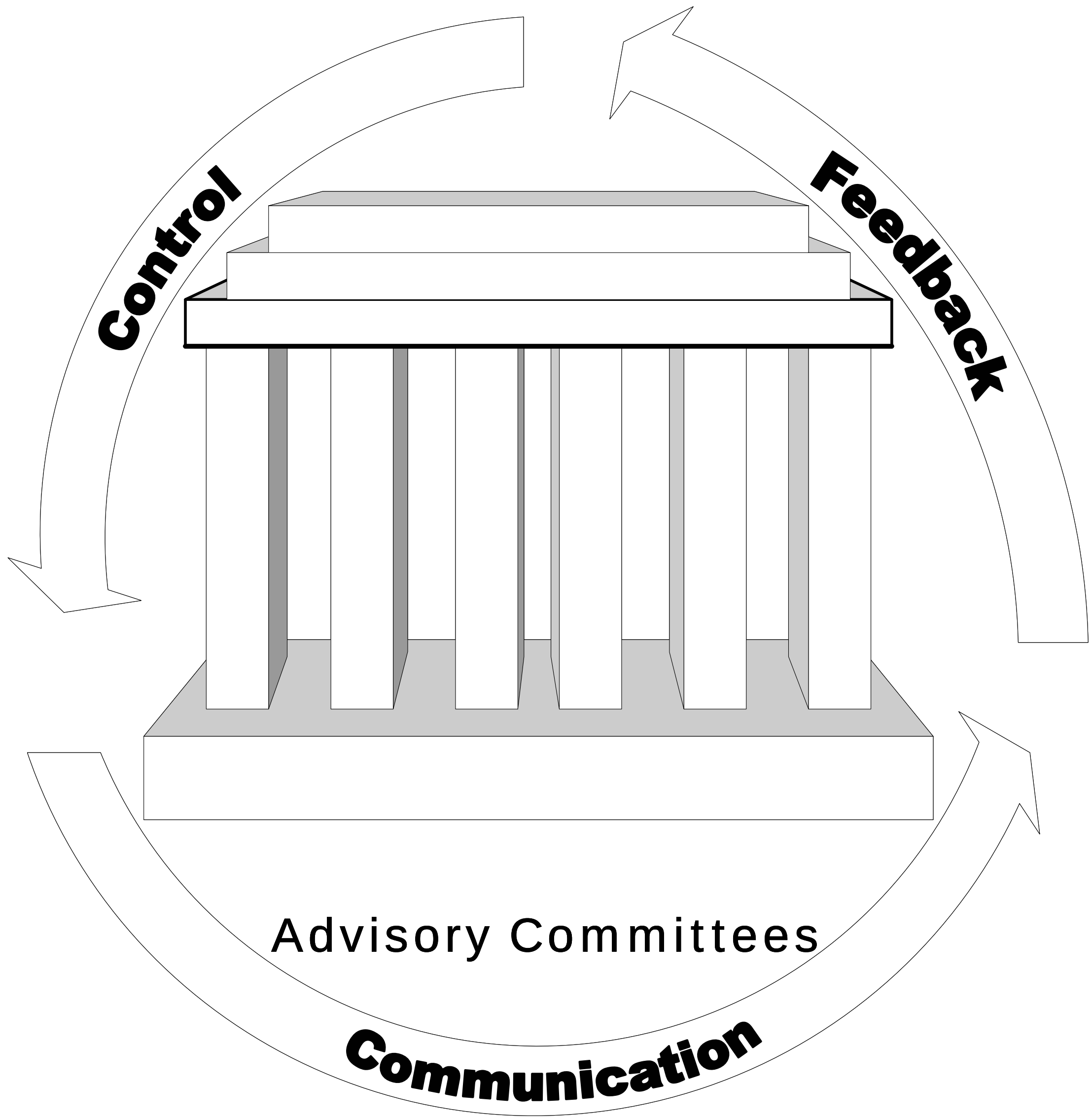

Figure 14. Proposed Revision to the GSM

in Chapter 2. Differences and similarities existed as predicted in the chapter on methodology. As for IRM, a set of key dimensions was determined for both the Federal perspective of IRM and IRM in general. Content analysis reduced the dimensions presented by Lewis, Snyder, and Rainer (1995) to those pertinent to this research. The relationship between these two sets, issues and dimensions, and the GSM was then explored.

The collection of current implementation issues and the identification of key IRM dimensions provided a base from which to analyze the GSM. In an effort to qualitatively assess the validity of the GSM representation of the issues and dimensions, a content analysis of the model and both the reported implementation issues and the identified key IRM dimension was conducted. The GSM proved to comprehensively represent both. With regard to the implementation issues, all GSM concepts accurately reflect current implementation issues. Communications issues, however, were not fully represented by the model and should be included in a revision. Turning to IRM, GSM concepts matched all key IRM dimensions except for the use of advisory committees. This was true for both the Federal IRM perspective and IRM in general. Overall, the GSM more than adequately represents the current GeoBase implementation issues and the key IRM dimension identified in this research. Minor changes would drastically improve the model.

Chapter V. Discussion

Chapter IV presented the results of this research effort. However, the greater meaning of the results was not covered. The discussion and implications of the analysis will be presented below. Then, the limitations of the research will be examined. Finally, suggestions for future research stream will be presented.

Implication of Research Results

The immediate answers to the research questions have further implications. As described in the analysis, the current GSM effectively models current and potential implementation issues. It also provides a framework for avoiding or minimizing the issues. In addition, the model represents the effective use of IRM to address the implementation issues associated with the insertion of the GeoBase concept into the USAF. The model reflects the GeoBase focus on IRM. Demonstrating its legitimacy in the IRM arena, the GeoBase IRM focus satisfies Federal (including the AF-CIO's) IRM requirements. These results of studying this cross-functional program also emphasize the applicability of IRM across functional domains.

IRM, if it has a home within the USAF, currently resides in the C&I community. However, the effective use of IRM by the GeoBase program to model sustainment implies IRM is an overarching discipline. Other information-rich programs, both within and outside the C&I community, may benefit by adopting an IRM focus similar to GeoBase. Adoption of a similar IRM focus may lead to the same awareness and avoidance of implementation issues and reduced sustainment efforts through low-risk investments experience by GeoBase as part of its implementation execution strategy. Because the an execution strategy focused on integrating IRM has proven effective in corralling cross-functional issues within the enterprise-wide GeoBase program, other cross-functional, enterprise-wide programs may benefit most. These types of programs generally have the most risk, and potential return, associated with them.

The introductory chapter of this thesis reported the high rate of failure for IS&T projects and the vast quantities of wasted resources associated with them. Also in that chapter, the lack of a unified insertion process for IS&T was cited. The greatest implication of this research may be the advent of a successful and universally applicable IS&T insertion and adoption strategy based on the GSM. Future research would be required to validate the thought.

Limitations of Research

The selected methodology and its execution present a few possible limitations to the results of this research. Stemming from the interpretation of the GSM, possible construct validity issues may exist. The apparent interdependency of GSM constructs may also present reliability issues. Reliability issues concerning the data sets must also be addressed. Finally, the sampling process must be mentioned. The following paragraphs will address these possible limitations.

A document detailing the purpose and definition of the GSM does not exist. Therefore, the researcher relied on the sparse information contained in other GeoBase documents for an interpretation of the model. These documents were augmented by personal communications with the HAF-GIO and HAF Garrison GeoBase Manager. However, it is possible that the concepts represented by the model were not adequately interpreted. Any misinterpretation of the model could lessen the construct validity of the research pertaining specifically to the model. However, the use of triangulation in determining the meaning of the model's concepts minimizes this possibility.

An interdependency of the GSM concepts, specifically the pillars, presented as a secondary finding of this research. Although the pillar concepts were considered mutually exclusive for the purposes of coding, the possibility exists that they are not. A high degree of interdependency leading to the concepts not being mutually exclusive could affect the reliability of the results. Follow-up analysis might not arrive at the same end. However, strict definition and testing of the coding process coupled with an initial review by informants reduced the possible degradation of reliability due to interdependency in the GSM concepts.

Reliability may also be affected by the data. Originally, the data collection involved hand scribed notes. These notes were transcribed and reviewed by the researcher and respondents to create a secondary data collection. Although both data sets were retained as per the methodology, it remains possible that the notes are too cryptic. The bulletized syntax and plethora of acronyms and jargon may prevent future analysis by other researchers. Review by the informants and the HAF Garrison GeoBase Manager demonstrated the data sets were interpretable by individuals vested with knowledge in the GeoBase environment.

The sampling process was purposefully not random. Although this practice is standard for qualitative research, it may affect the external validity of the findings. The three case study sites may have been an insufficient quantity. Furthermore, the chosen sites may not have been representative. Careful analysis of the MAJCOM characteristics and relative degree of progression in the implementation phase was accomplished by the researcher and the HAF Garrison GeoBase Manager to mitigate any non-random effects. In addition to the case selection, the determination of literature and documentation included in the analysis may affect the external validity. The researcher initially chose the literature and documentation at random, including all pertinent resources found through various database searches. However, a conscious decision was made to focus on IRM literature that presented a comprehensive examination of key IRM dimensions. Literature included was predominately composed of content analyses of previously published IRM research. This meta-analytic approach may have introduced unintended biases. To minimize any possible bias, the research made a concerted effort to ensure no document found, but not included in the analysis, discussed a major area or dimension of IRM not already mentioned by literature included in the analysis. Major dimensions included in the analysis are, therefore, comprehensively exhaustive of all major dimensions presented in all IRM literature reviewed.

Suggested Future Research

The GeoBase program has not been in existence for an extensive period. Therefore, little research focused on the program has been accomplished. GeoBase is also not the only capability-based, technology-supported, information-rich and focused program in existence. Therefore, many systems may benefit from research conducted with respect to GeoBase. Interesting, pertinent, and fruitful topics for future research will be briefly mentioned in the following paragraphs.

Quantitative evaluation of GSM.

The qualitative assessment of the GSM with respect to both implementation issues and IRM sets the foundation for a detailed, quantitative analysis, validating the GSM. Given the list of implementation issues documented and key IRM dimensions identified in this research, a survey instrument could be developed for the proposed research objective. An electronic survey could easily be delivered to the entire population of GeoBase implementation sites. Alternatively, the impending GeoBase Compass Conference could be used as a data collection venue. The results of such a comprehensive data collection methodology could quantitatively validate the premises of the GSM as an implementation and IRM model, possibly providing the framework for a "coherent service-wide insertion process" for IS (Cullis, 2000a, p. 23).

Interdependency of GSM concepts.

This research revealed, as a secondary observation, a perceived dependency between the concepts represented by the GSM. As the research was not intended to explore the interdependency, the area remains untracked. Future research may be able to indicate a hierarchy between the concepts or pillars. Perhaps, a mutually exclusive, comprehensively exhaustive set of concepts might be discovered to replace the current pillars. Such a set may have no interdependency and clarify the model.

GeoBase and IS success.

The GeoBase technical solution remains an IS. Therefore, IS success models may be able to predict the future of the program. Will the program be successful? What are the appropriate measures of success with respect to GeoBase? Does the GSM adequately capture the key factors in IS success? These types of questions remain unanswered, though future research may provide such answers.

GeoBase and Taxonomy.

Respondents cited the limits of the current data standards within the GeoBase program as a significant issue affecting implementation. Similarly, research has been conducted on the creation and use of a data and information taxonomy with respect to data and information storage and retrieval. Taxonomy research identifies the need to formalize a clear and useful categorization scheme for identifying stored elements for later retrieval from a database. The requirements identified in the taxonomy research can be applied to the data standardization requirements of the GeoBase GIS database identified by this research. Applying taxonomy principles to GeoBase, future researcher may help create a standard data set fulfilling the needs of the practitioners as identified by this research.

GeoBase Sustainment.

Do the issues during the sustainment phase of GeoBase differ significantly from those during implementation. At some point in the near future, the GeoBase program will transition from the implementation phase to sustainment. Will the GSM remain an adequate model as the name implies?

Examination of the Installation Visualization Tool.

The GeoBase program has gained attention at the DoD level. As such, a similar cross-service program has been launched. The new program is currently dubbed the Installation Visualization Tool (IVT). Spawned from the GeoBase program, IVT may be faced with many similar issues. A focus on the key dimensions of IRM may prove as useful in easing the implementation process for IVT as it has for GeoBase. However, the cross-service environment contrasts with the USAF's (i.e., leadership styles and directiveness, location and method of operations, etc.). These similarities and differences between services make for an interesting area of study. All the suggested areas of research for GeoBase also apply to the IVT program.

Other information-based programs.

The GeoBase program grounds itself in information theory and utilizes an IS as the technical solution. Therefore, extending this research to similar information-based programs may be appropriate. The GSM serves the GeoBase program well. Do other programs have such models to guide their implementation efforts? How do other programs compare to GeoBase (implementation issues, IRM, success)? Much unexplored territory still exists in the USAF as well as a broader environment.

Summary of Discussion

The GSM satisfactorily represents the implementation issues facing the GeoBase program as well as the key dimensions of IRM. In addition, a clear articulation of the model's concepts, explicit reference of communication, and inclusion of advisory committees would enhance the GSM. The resultant model should be researched along with the other proposed areas given in this chapter. Building on the research recorded in this document, the GSM may be shown suitable for a DoD-wide insertion model for information-based, technology-enabled programs and other IS&T initiatives. The model would fill the void for such a model identified in the introductory chapter, increasing success rates and reducing expenditures resulting from failed projects.

Appendix A. Acronym List

AF-CIO: Air Force Chief Information Officer

AF/IL: USAF Deputy Chief of Staff for Installations and Logistics

C&I: Communications and Information

CE: Civil Engineer

CCA: Clinger-Cohen Act of 1996 (formerly ITMRA)

CIO: Chief Information Officer

CONOPS: Concept of Operations

CtO: Certificate to Operate

DoAF: Department of the Air Force

DoD: Department of Defense

GIO: Geo Integration Office *or* Geo Integration Officer

GIS: Geographic Information System

GSM: GeoBase Sustainment Model

GPS: Global Positioning System

HAF: Headquarters Air Force

HRM: Human Resource Management

INFOSEC: Information Security

IT: Information Technology

ITMRA: Information Technology Management Reform Act

IRM: Information Resource Management

IRMC: Information Resource Management College

IRMer: Information Resource Manager

IS: Information System

IS&T: Information Systems and Technology

MAJCOM: Major Command

NDU: National Defense University

OMB: Office of Management and Budget

OD: Organization Development

SDS: Standard Data Set

US: United States

USAF: United States Air Force

Appendix A. Investigator Protocol

Instructions to investigator: Introduction. Provide copy of case study read ahead prior to site visit. At the beginning of the first group session, read through disclaimer and research background. Ensure attendees are familiar with the intent of the research and the concepts thereof.

Note: All applicable documents should be requested and collected while on site. In addition, observation should also occur. Telephone calls and meetings represent prime opportunities.

Disclaimer: The research associated with the interviews conducted during the site visits is wholly academic in nature and not connected with any GeoBase reviews, initiatives, or staff visits.

Note: Purpose of disclaimer is to assure recent and concurrent HAF-GIO reviews not associated with, reliant on, or using research in any fashion.

Research Background: The researcher is a captain in the AF and a graduate student in the Information Resource Management (IRM) program at the AF Institute of Technology. As part of the graduation requirements, the researcher must complete a thesis research project. The topic chosen, in collaboration with the Headquarters Air Force Geo Integration Office (HAF-GIO), concerns the relationship of IRM and GeoBase. The research has two main objectives:

- **Validate Elements of GeoBase Sustainment Model** (the six pillar HAF-GIO model)
- **Identify IRM Practices Inherent to GeoBase Sustainment Model**

These objectives boil down to identifying implementation issues experienced by those within the GeoBase program and relating them to a set of information management practices with respect to the GeoBase Sustainment Model. Three main goals are expected as a result of the objectives:

- **Catalogue Implementation Issues**
  - Provide Visibility of Issues Back to GeoBase Community
- **Further GeoBase Legitimacy by Demonstrating Adherence to AF-CIO Policy**
- **Provide Validated Model for Sustainment Through Low-risk Investments**

These results should provide a mechanism to enhance GeoBase operations through sound resource management.

Instructions to investigator: Background. Stress personal information is only for investigators perspective and setting context. Question 4 could be key to MAJCOM's program and establishing theoretical replication.

Note: Provide attendees ample time to fully articulate all comments. Wait for appropriate pauses to seek clarification and for follow-up questions. Capitalizing on the nature of the group session, allow brainstorming of ideas. Tangential ideas can be fleshed out as the comments lull.

Section I. Background: Individual information from this section will not be included in any fashion within the final report. Information facilitates an understanding of the issues (for instance personnel in the same duty position do/do not experience similar implementation issues) and follow up if necessary.

1. What is your name?

2. What is your current duty title?

3. How long have you worked in your current position?

    a. If less than one year, did your previous position fall under the GeoBase program?

    b. Have you held any other positions in the GeoBase program?

4. What unique perspective does your MAJCOM have that effects the GeoBase program (i.e., pervading culture, relationship between bases and HQ, etc)?

Section II. Implementation Issues: Challenges, obstacles, lessons learned, best practices, etc associated with the introduction and continuance of the GeoBase initiative.

Instructions to Investigator: Implementation Issues. Ensure adequate time is spent on issues in general. As the first question is open-ended and outside the GSM construct, the question may be key to identifying issues not modeled currently. The final question could be vital for the same reasons despite the possibly exhaustive nature of the other questions.

What GeoBase implementation issues, positive or negative, have you (or your base-level offices) experienced? If possible, please differentiate between base and MAJCOM-level issues. Please also describe any existing policies, practices, processes, or other mechanisms your/your office has to address, overcome, or enhance these implementation issues.

    a. Have you encountered issues directly related to systems architecture (information technology)?

i. If yes, what issues?

ii. In what ways do you currently address these issues?

b. Have you encountered issues directly related to financial management?

i. If yes, what issues?

ii. In what ways do you currently address these issues?

c. Have you encountered issues directly related to policy and guidance or the lack there of?

i. If yes, what issues?

ii. In what ways do you currently address these issues?

d. Have you encountered issues directly related to education and training or the lack there of?

i. If yes, what issues?

ii. In what ways do you currently address these issues?

e. Have you encountered issues directly related to human resource management, including what people are needed to manage GeoBase activities, how the people are organized and staffed, what their responsibilities are, etc?

i. If yes, what issues?

ii. In what ways do you currently address these issues?

f. Have you encountered issues directly related to information architecture (data, metadata, security, etc)?

i. If yes, what issues?

ii. In what ways do you currently address these issues?

g. Have you encountered any other issues unrelated to the previously discussed topics?

i. If yes, what issues?

ii. In what ways do you currently address these issues?

Instructions to investigator: Completion. Once the instrument has been completed and all necessary clarification and follow-up has been accomplished, type up the interview notes. Send each participant a copy of the notes and request a review. For the review, each participant should add any additional comments and correct any errors in content or context. Use of Track Changes in MS Word facilitates the investigators review and allows copies to be saved for the "chain of evidence". When each reviewed copy is received by the investigator, he should note any changes or additions. Any clarification or follow-up should be conducted with the individual reviewer. Once all revisions have been reviewed and acted upon if necessary by the investigator, a final group session should be conducted. Edits should be discussed, which may spur more discussion. A final opportunity to add comments should also be given.

Appendix C. Site Visit Read Ahead

Disclaimer: The research associated with the interviews conducted during the site visits is wholly academic in nature and not connected with any GeoBase reviews, initiatives, or staff visits.

Research Background: The researcher is a captain in the AF and a graduate student in the Information Resource Management (IRM) program at the AF Institute of Technology. As part of the graduation requirements, the researcher must complete a thesis research project. The topic chosen, in collaboration with the Headquarters Air Force Geo Integration Office (HAF-GIO), concerns the relationship of IRM and GeoBase. The research has two main objectives:

- **Validate Elements of GeoBase Sustainment Model** (the six pillar HAF-GIO model)
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These objectives boil down to identifying implementation issues experienced by those within the GeoBase program and relating them to a set of information management practices with respect to the GeoBase Sustainment Model. Three main goals are expected as a result of the objectives:

- **Catalogue Implementation Issues**
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- **Provide Validated Model for Sustainment Through Low-risk Investments**

These results should provide a mechanism to enhance GeoBase operations through sound resource management.

Section I. Background: Individual information from this section will not be included in any fashion within the final report. Information facilitates an understanding of the issues (for instance personnel in the same duty position do/do not experience similar implementation issues) and follow up if necessary.

1. What is your name?

2. What is your current duty title?

3. How long have you worked in your current position?

    a. If less than one year, did your previous position fall under the GeoBase program?

b. Have you held any other positions in the GeoBase program?

4. What unique perspective does your MAJCOM have that effects the GeoBase program (i.e., pervading culture, relationship between bases and HQ, etc)?

Section II. Implementation Issues: Challenges, obstacles, lessons learned, best practices, etc associated with the introduction and continuance of the GeoBase initiative.

What GeoBase implementation issues, positive or negative, have you (or your base-level offices) experienced? If possible, please differentiate between base and MAJCOM-level issues. Please also describe any existing policies, practices, processes, or other mechanisms your/your office has to address, overcome, or enhance these implementation issues.

a. Have you encountered issues directly related to systems architecture (information technology)?

i. If yes, what issues?

ii. In what ways do you currently address these issues?

b. Have you encountered issues directly related to financial management?

i. If yes, what issues?

ii. In what ways do you currently address these issues?

c. Have you encountered issues directly related to policy and guidance or the lack there of?

i. If yes, what issues?

ii. In what ways do you currently address these issues?

d. Have you encountered issues directly related to education and training or the lack there of?

i. If yes, what issues?

ii. In what ways do you currently address these issues?

e. Have you encountered issues directly related to human resource management, including what people are needed to manage GeoBase activities, how the people are organized and staffed, what their responsibilities are, etc?

i. If yes, what issues?

ii. In what ways do you currently address these issues?

f. Have you encountered issues directly related to information architecture (data, metadata, security, etc)?

i. If yes, what issues?

ii. In what ways do you currently address these issues?

g. Have you encountered any other issues unrelated to the previously discussed topics?

i. If yes, what issues?

ii. In what ways do you currently address these issues?

Appendix B. MAJCOM A Interview Data (Consolidated and Organized)

Unique MAJCOM Perspective:
- Business Culture: business mindset and practices likely different than other MAJCOMs
  -- MAJCOM leadership not very directive; allow bases to call own shots, very little top down push
  -- MAJCOM & bases focus on business case; must be compelling enough to change status quo
- EAs mainly non-deploying civilians; small GeoReach need (Eglin & Hill) weakens business case
- Leader in automapping (1980s); led to continued use of products and technology--created foundation for intelligent use of automated maps and GIS (term "automapping" is not part of industry terminology; some readers may assume it means Autodesk Map, which is a software product)
  -- Continual automap use ensures those who need to know what data/products exist do know
  -- Long data history = high data quality
- MAJCOM/SC focused on "how do you use IT to do a good job" vs connectivity
  -- Enterprise view helps GeoBase process--seeks smart, sharable, and standardized solutions
- 9 of 12 bases use Garrison GeoBase; all installations included in Strategic GeoBase (Strategic GeoBase is implemented at the HAF, not at the installation level)
  -- 2 sites (Battle Creek Federal Center and Brooks CityBase are leased properties)

General Implementation Issues:
- GeoBase considered black-box, plug-and-chug solution; infeasible w/o firm architecture, guidance (champion), and funding
- Base-level focus = maintaining independence--MAJCOM focus = funding & top-level support
- "Show me the money and I will follow your guidance" attitude; GeoBase = mandated unfunded--plenty of Garrison guidance; still need much funding

Systems Architecture Issues:
- Continual automap use led to large legacy investments--major cause for resistance to change; greater consideration for legacy investments required in current architecture
- Require further guidance transitional and on to-be architectures; difficult to create exit strategy (and compelling case) from legacy products w/o--need specifics to create impetus for change
  -- 4 of 9 bases use industry standard, ESRI; AF main customer for major alternative, Intergraph
- Lack of specification detrimental to credence of position; harder to pass off ideas
  -- Understand infancy of program & required flexibility at this stage, though

-- Understand blanket standards not always best; must accommodate legit differences (emphasis here is the difficulty that some MAJCOMs have had marrying HQ vision with installation vision when a top-down attitude forces users where they don't want to be.)

Financial Management Issues:

- Misunderstanding between CE & functionals (especially SC) for funding--clarified roles in CONOPSv2
- Funding POM'd, but not seen--estimate FY06 before actual money flows
  -- Bases (mainly through CE) already funding GIS services or GeoBase-type activities--see change in color of money as lost control/funding
- Sustainment of people not included; need funds for FTE

Policy and Guidance Issues:

- Lack of champion/leadership push (CE or otherwise) creates slower, step-wise implementation environment
  -- Every "baby step" submitted as business case for HQ leadership blessing; still fight bases
  -- Each installation voice equally powerful; no single entity has its way--Oracle SDO solution represents implementation tool to satisfy most parties; causes
    --- ESRI product family for GIS capability still uses Oracle, SQL Server, etc. for a backbone database; focus on SDO because of the potential to lessen throw-away of existing investments in geospatial data and GIS application of that data
    --- GeoBase architecture document stresses capability not IT solution to facilitate
- MAJCOM guidance should be issued as new guidance for old business (what is already being done)
- Strategic GeoBase guidance has been a moving target; constant change due to politics--need more & better guidance. (Note that Strategic GB is so visible at highest levels in DoD/USAF that opinions and input come from multiple key organizations and people. Trying to meet all has kept it more of a moving target, but this ship is closer to tying up at the dock.)

Education and Training Issues:

- No issues for mature installation, installations with similar or same solution in place
  -- Larger learning curve for bases new to GIS--have specific regimen for setup, admin & mx
- SC good support; negotiating enterprise license w/ <u>support</u>
- Need more/better education (PR/advertising) for leaders and end users who are unaware of GeoBase products/services--need GeoBase missionaries

HRM Issues:

- EM separate division from CE at MAJCOM & installations--leads to communication and financial issues
- People need good marketing skills while maintaining sufficient technical knowledge
  -- Base-level GIOs still in works--must "sell" position to installation annually

- High number of contract civilians as support PERS--advice taken with grain of salt; stigma of contractors vying for personal gain only (e.g. increase project size)
- Need better top-to-bottom buy in--“success based on people”
- Installation GIO; serves as extra layer of mgt only--not as familiar with traditional CE geospatial data needs or other functionals’ business
- A-76 of CE and/or EM creates MEO w/ less PERS; too many levels of complexity for remaining PERS--creates retaining issues
- CE has tools, PERS, and capability for mapping; need functionals to fund MDS geospatial (geographic as partnership) and maintain DB w/ attributes, etc--will reduce overall resource expenditure (PERS reqt, eqpt procurement, etc)
- Propose base-level GIO as part of working group w/ functional reps; increases buy-in and leads to better solutions (e.g. server consolidation→right fnc people access to NCC, right trng for SC PERS)

Information Architecture Issues:
- Large legacy investment led to the five major installations to have GIS or GIS-like data
  -- Data sets not alike; mapping and attribution varied on focus, nomenclature, and completeness--standardization still lacking
- Testing weeds-level structure guidance/SDS CIP standardization--will facilitate audits of DB and cross comparison; reduces differences in nomenclature/taxonomy (and interpretations thereof)
- Misconception concerning data, data accuracy, and data definitions
  -- Base boundary provided early example: what does accuracy mean? First, what does boundary mean--legal, notional? Can original documentation be found? How old is too old? When was last update and how often should it be updated? What are the pin down points? How good are the pin down points? Field mandatory? Binary field input?
  -- Need to be clearly defined in info arch then captured in metadata
    --- Specific minimum standards given; Constraint, Wetlands, Flood Plain, and QD Arc (not just ordnance: EM fields, LOX, fuel, etc) Layers but some discussion continues. Any data call from multiple owners finds that someone will spend time justifying the “correctness,” or apologizing for the quality of what they provide. Think we’re still hearing more of those concerns than any real issues about the data specifications. The Quality Assurance Plan, or QAP, should alleviate much of this. Much clarification should come out of the HAF GIO’s Strategic GeoBase Workshop to be held at the Pentagon, 29 Sep – 2 Oct.

Miscellaneous Issues and Comments:
- <u>Unlisted benefit</u>: knowledge of common implementation issues may lead to recognition various MAJCOMs not so different after all
  -- Likely encountering similar issues to other MAJCOMs
- Fixed base missions more important--a stronger emphasis on Garrison GeoBase than other MAJCOMs who have a greater war-fighter perspective
  -- Leads some other MAJCOMs to lean first toward GeoReach or Expeditionary needs, while Garrison GeoBase is a second thought--changing, but still out there

Appendix C. MAJCOM B Interview Data (Consolidated and Organized)

Unique MAJCOM Perspective:
- Active in all GeoBase arenas (GeoReach, Expeditionary GeoBase, and Garrison/Strategic GeoBase); focus on hot spot (i.e., initial focus on Garrison, OEF shifted to GeoReach, back to Garrison before OIF)
  - -- MAJCOM-GIO charged with GeoReach & Garrison/Strategic GeoBase; not currently staffed to robustly pursue both simultaneously--anticipate fuller staff in near future due to recent funding
- High number of installations (16) increase spectrum of implementation stages; harder to find common ground--additional resource, especially PERS, required to keep program on track

General Implementation Issues:
- Certificate to operate process difficult; GeoBase program does not fit SC framework for accreditation process--not a system, not an application (e.g. COTS product); SC looks to AFIs, but interpretation varies; creates moving target
  - -- No overall HAF GIO push for certification; MAJCOM responsible for solution & CtO
  - -- Requires more coordination and documentation = slow implementation

Systems Architecture Issues:
- Data Access Issues Created by Question of What Data to Share and How
  - -- Cannot Access Data Outside Firewall
- Difficult to work with COMM on establishment of a Memorandum of Agreement (MOA)
- Bases motivated toward successful implementation of transitional arch; lack of solid guidance delays transition

Financial Management Issues:
- Funding Not Available for Data Collection--Ex: Partnered w/ AF CE Services Agency (AFCESA) for utilities data collection; AFCESA support reduced after MAJCOM funds ($6M) obligated
  - -- Result = reduced number of features/attributes collected
- POM forecast currently to HAF level only; MAJCOMs have no visibility into future funding support levels from HAF-GIO--know $X POMed; do not know MAJCOM distribution
  - -- Annual review and current policies and guidance (e.g. CONOPS and Arch) provide general strategy for prioritization
- Decentralized program requires MAJCOM POM for funding; future base-level requirement
  - -- Poor communication from HAF-GIO on funding leaves MAJCOMs on lurch; HAF failed to reveal funding line nor priority in timely fashion (Jan in FY03)

--- Other sources (MAJCOM, Cost of War, GWOT) expect unfunded list; cannot make case without HAF funding line
-- Requires better coordination/plan between HAF and MAJCOM GIOs for who will go after what funding (how much, for what & when)
--- Use matrix to visualize long-range plan and short-term goals for MSG & CE/CC "buy in"--weans bases off MAJCOM funding ~FY05-08; time for program to "catch on"
-- Sustainment phase may lessen issue if costs easier to determine due to more stable program
- GeoBase PEC not clearly defined; initially nothing labeled GeoBase, now everything
-- MAJCOM comparisons difficult (e.g. ACC may code $5M, AMC $25M; etc; overall cost same)
-- Over inflation of pure GeoBase expenditures makes program appear costly; goal of program to be low cost, high capability→ smarter way of doing business not more costly
-- Movement to categorizing expenses as GeoBase indicative of program growth in legitimacy
-- Need guidance and educate should be in PEC; pure GeoBase included (i.e., training, PERS, hardware for serving data)--use other PECs for separate requirements (PCs, utilities, etc)
--- Functionals (Data Stewards) must POM for continued and additional costs (must be in coordination with/assistance from MAJCOM-GIO)
- GeoBase seeks to change how functionals perform activities; new smarter, integrated method
-- Funding largely exists since already performing; functionals still expect additional funding

Policy and Guidance Issues:
- Use policy memos with what, why, when, and where (vision/direction) not firm guidance
-- Funding enforces policy; avoid mandated unfundeds--base view = no money, no action
-- Bases use installation specific strategic plans for phased implementation; MAJCOM provides expertise--directive only if base going off track; engages CES/CC
-- Initial reaction to lack of firm guidance quelled by education effort
- Lack of clear guidance defining demarcation point between GeoReach and Expeditionary GeoBase leads to extra taskings by MAJCOM-GIO in support of Expeditionary GeoBase
-- Leadership whims and make-it-happen attitude increase need for guidance
- Flexibility of current guidance beneficial to transition; timeliness ties MAJCOM's hands
-- MAJCOM ready to press, but HAF promises new guidance; MAJCOM wary about pressing ahead when guidance may require different direction--leadership not please with slow roll

-- Hope current trend of general guidance continues without retro-restrictiveness, which might cause changes in direction (and possible loss of current investment)--HAF good job of communication before issuing new guidance to avoid issues (e.g. minimums in CIP requirement generated through talks with MAJCOMs after identified previous guidance too loose)

Education and Training Issues:
- 15 of 16 installations have EA mobility commitment--AFCESA incorporated training in tech school; Silver Flag included training, but not garrison GeoBase--small portion of EA job
- Rely primarily on only one class, provided by NIMA, for AF civilian training
- Understands importance of a training program but to date has not been able to address as a high priority--heavy dependence on contract support; no plan if bases do/can not support contract PERS in future--attempt to involve more blue suiters
- Lack of HAF guidance/plan--no plan to educate leadership
  -- Difficult for MAJCOM to develop training due to resource redundancies--need big picture not narrow MAJCOM focus; should involve schoolhouse (currently in the works); must address all levels: senior leaders down to worker bees
- MAJCOM-GIO strong focus on educating MAJCOM and base leadership; provides leadership knowledge and tools (cheat sheets, etc) to involve selves in program--no plan to train data stewards at this time (priorities)

HRM Issues:
- Blue Suit Deployment Rate = Poor Continuity; High Home-station OPSTEMPO = Low Priority for MDS Maintenance
- MAJCOM-GIO (under CEO) responsible for GeoReach & Garrison/Strategic GeoBase; lacks authority over GeoReach staff (under CEX)--resources still pulled to meet GeoReach taskers
- Better defined working relationship (boundaries/roles & responsibilities) with SC required (e.g. MOA required for server maintenance)
  -- Lack of functional flexibility and understanding = inconvenience, low value, and delays
- Actively involves base leadership; does not work exclusively with base GIO
  -- Funds and controls contract for base-level GIO PERS; let base leadership run program
- Interplay between AD, AF civilian, and contract PERS at odds based on existing cultural norms; need to break barriers--has implications concerning training and implementation (base-level) concerns on split of work, trustworthiness of contractors (what is contractors incentive for recommendations), capabilities of AD, etc
- Uses existing working groups vice adding additional meetings or stovepipe groups
  -- Educate on capabilities and define direction of program
- MAJCOM/CE huge proponent and champion of GeoBase; leads charge in MAJCOM
- Future funding for contract PERS unclear; leads to manning questions

-- AD adequately trained? Dual-hatting AD or AF Civ sufficient? Where bodies come from?

- Structure and location of base-level GIO left to installation--map-centric nature and data requirement focus effort in CES; may evolve outside CE as program grows
  - -- All started under CE Flt; some grown to separate Flt; some other functional areas creating GIO around MDS steward

Information Architecture Issues:

- MAJCOM and installations awaiting INFOSEC guidance; no hard stance/policy from HAF
  - -- Currently defer to base-level PA (similar to base map, phone directory, etc)
  - -- Rely on network security (domain access control: logons, Firewall, etc) to protect data
- Data sharing across firewall major issue; difficult to update data (cannot txfr across network)
  - -- MAJCOM data requirement minimal; bases will have own server with full database--currently share data via transfer of disc media once the CtO has been approved.
- HAF attribute definitions not rigorous enough; left too much room for interpretation/variation
  - -- Published own interpretation of SDS model to provide better standardization (which attributes to use & metadata for attributes
  - -- HAF plans to issue improved guidance; MAJCOM cannot afford to wait--slow roll may wreak havoc if does not match MAJCOM solution = back and forth changes
    - --- Would damage program credibility by constantly asking the installations to change their implementation
- GeoReach security classification major challenge; GIOs not familiar with processes/do not have means to address issues
  - -- HAF push to work with unclassified materials; imagery often classified
  - -- Declassification of media left to MAJCOM; should be HAF plan
  - -- Transportation and transfer of data from classified system to field troops unsolved

Miscellaneous Issues and Comments:

- Lots of time spent recovering from overselling/bad advertising; PERS and guidance big players
- Standardization driven by need to integrate (with legacy systems) and normalize data dictionary

Appendix D. MAJCOM C Interview Data (Consolidated and Organized)

Unique MAJCOM Perspective:
- Culture expects/wants downward direction/clearly defined boundaries; HAF-GIO "hands-off", loose guidance strategy not necessarily compatible--HQ more directive as a result
- May be only MAJCOM to contract three sources (CH2M Hill, SAIC & Tesseract) of GeoBase support for technical issues and application development--supports single solution vision while providing competition/creativity independent of platform
- MAJCOM-GIO adopted fast follower mentality; capitalized on other MAJCOM lessons learned
    -- Strongly undersell, over deliver; proceed in slow calculated steps--slow at first, but gain efficiencies and effectiveness by not reinventing the wheel

General Implementation Issues:
- Implementation plan, data conversion contract, and provided standard solution established solid baseline for all 12 installations--able to do so due to leadership personalities, lack of GIS history or baggage, etc; no outside constraints

Systems Architecture Issues:
- Strong proponent of single standard solution; provides continuity and efficiencies in EA training/proficiency and program support
    -- Did not direct single solution; Microstation and AutoCad acceptable--support provided primarily for ESRI, including contracted technical support
  -- Vision: Trimble and ESRI as standard solutions across MAJCOM to eliminate redundancies and wasted resources chasing different directions--has eliminated sys arch issues
  -- Recommend as AF standard (or request any single standard)

Financial Management Issues:
- HAF funding sufficient to start program rolling--larger issue = selling need and future capability of GeoBase program; bases view GeoBase as nice to have not must pay requirement
    -- Leadership recognizes potential of GeoBase and has filled funding gap--avoids mandated unfundeds by providing bases 90% solution, including contract support
  -- Use base visits to promote GeoBase capabilities

Policy and Guidance Issues:
- Lack of standardized AF training program problematic
  -- Contingency requirements demand AF-wide continuity and standardization
  -- Recommends incorporating GeoBase requirements into 3, 5 & 7-level upgrade training

-- Need approved AF-wide metrics, stemming from standardized training, for accountability/compliance--must first identify how to test knowledge (UCI, ORI style?)

Education and Training Issues:
- Training important and plans under construction; other issues have taken precedence--plan contractor run training in next 6 mos
  -- Oracle-based, to-be architecture demands expertise not established in MIL or civ sectors

HRM Issues:
- Insufficient MAJCOM PERS; only three PERS in GIO; cannot keep up with large divergence in bases' levels of implementation, especially fast movers
  -- Focus on one issue at a time; fighting fires--expect contract support to alleviate
- 18 month rotations through GIO office and matrix management caused leadership gaps at critical junctures--some installations have knowledge gaps as well = poor implementation
  -- Some tasks can only be accomplished by MIL PERS; creates delay at minimum
    --- MAJCOM/CEO involvement/program knowledge boosts program/helps cover HQ gaps
  -- Anticipate leadership/MIL issues until spiral 2/4 when all 32s familiar with program
- Have established clear vision of base-level GIOs; published road map specifies current minimum organizational requirements within CES (GS-11/12 as Base-GIO, 2 GS-7 analysts) and future vision (Maj as GIO under MSG)
  -- Do not have clear vision of where to "steal" bodies from or acquire necessary funding
- Some bases entrenched in old ways, many nay-sayers--countered by strong champions
  -- Use team concept to create change through HQ, base-level, and airmen proponents
- Program based on cross-functional integration; horizontal integration with vertical visibility--problematic elevating program out of CESes; other functionals do not see their role or benefits
  -- Have not been able to realize synergies between units
  -- Use conferences, meetings, partnerships, etc to overcome issue

Information Architecture Issues:
- INFOSEC pervasive issue with bases; what is proper balance of security and operational need
  -- Base-level CCs concerned with quantity and type of information stored in single location; MAJCOM HQ recognizes issue, but identifies other sources as similarly contentious and already proliferating info (rogue PERS, base phonebook and maps, commercial internet imagery sources)
  -- Recommends serving info from NIPRNET; relies on network security procedures/protocols to protect info (e.g. file permissions based on job requirements)

- PA charges with GeoBase information release--does not have expertise in area; no decision matrix or guidance exists to determine releasability--no requirement for release so far
- Strategic GeoBase requirements/definitions for data fields/metadata moving target
    -- Causes discrepancies in reporting and reiterations of work; difficult to meet deadlines with accuracy
  -- Need appropriate yard stick/metric & provide better guidance

Miscellaneous Issues and Comments:
- Must change AF culture to understand how new GeoBase process adds value
- Public release of base's information can be restrictive in future; public decisions based on released information bind base's future actions (e.g. release of reduced noise contours or QD arcs may result in more encroached building by private sector or local govt; base may not be able to take on future changes in mission which increase noise contours or QD arcs)

Appendix E. Reported GeoBase Implementation Issues

Reported Implementation Issues	MAJCOM A	MAJCOM B	MAJCOM C
Coordination with Functional Communities	✓	✓	✓
Customer Awareness of Capabilities/Benefits	✓	✓	✓
Functional Cultural Differences	✓	✓	✓
GeoBase as Perceived Unfunded Mandate	✓	✓	✓
Insufficient GeoBase Personnel	✓	✓	✓
Leadership (Support, Style, Personality)	✓	✓	✓
Legacy Investment Requirements	✓	✓	✓
Minimum Data Requirements (Completeness) Lacking	✓	✓	✓
Organizational Position/Reporting Chain of Base-GIO	✓	✓	✓
Program Champion Present	✓	✓	✓
Specific To-be Architecture Lacking	✓	✓	✓
Standard Architecture Definitions Lacking	✓	✓	✓
Standardized Data Sets Lacking	✓	✓	✓
Unified/Centralized Training/Training Plan Lacking	✓	✓	✓
Change Management Practices	✓	✓	
Decision-making Impetus	✓	✓	
Focus (Garrison vs Deployed)	✓	✓	
Funding Responsibilities Unclear (MAJCOM-level)	✓	✓	
Guidance Not Clear (Moving Target)	✓	✓	
Key Players Not Under Same Chain of Command	✓	✓	
Management Styles (Micro vs Macro)	✓	✓	
Military, Civilian, and Contractor Stereotypes	✓	✓	
No Money, No Action	✓	✓	

Reported Implementation Issues	MAJCOM A	MAJCOM B	MAJCOM C
Number of GeoBase Programs Managed	✓	✓	
Data Accuracy	✓		✓
GeoBase Personnel Funding Lacking	✓		✓
Hiring Pool Lacks Experts	✓		✓
History with Mapping/GIS	✓		✓
Leadership/Organization Directiveness	✓		✓
Multiple Technical Solutions	✓		✓
Lack Clear INFOSEC Guidance		✓	✓
Poor Personnel Continuity		✓	✓
Training/Training Plan Not Current Priority		✓	✓
Base-level GIO Required	✓		
Data Refresh Requirements Not Clear	✓		
Funding Responsibilities Unclear (Base-level)	✓		
Info Collection and Maintenance Process Not Clear	✓		
Large Learning Curve for Beginner Bases	✓		
Personnel Retraining Requirement High	✓		
Perspective (Strategic vs Tactical)	✓		
Solution Approach (Technology vs Capability)	✓		
Standardized Nomenclature of Data Attributes Lacking	✓		
Centralized Efforts Lacking		✓	
Data Collection Funds Lacking		✓	
Data Sharing Across Firewall Difficult		✓	
Expectations of Military, Civilians, and Contractors		✓	
GeoBase PEC Not Clearly Defined		✓	
Guidance Not Timely		✓	

Reported Implementation Issues	MAJCOM A	MAJCOM B	MAJCOM C
In-house GeoBase Training Unavailable		✓	
Number of Implementation Sites Within Command		✓	
Qualified Military Personnel Lacking		✓	
Adoption Strategy (Leader vs Follower)			✓
Not Viewed as "Must Pay" by Other Organizations			✓
Tasks Personnel Dependent			✓
Tech Solution Dependencies			✓

Appendix F. Reported Implementation Issues Categorized per GeoBase Sustainment Model

Reported Implementation Issues

Cultural Issues:

- Adoption Strategy (Leader vs Follower, Fast vs Slow)
- Decision-making Impetus (Business vs Operational)
- Expectations of MIL, Civilian, and Contract Personnel
- Focus (Garrison vs Deployed)
- Functional Cultural Differences
- History with Mapping/GIS
- Perspective (Strategic vs Tactical)
- Solution Approach (Technology vs Capability)

Systems Architecture:

- Leadership (Support, Style, Personality)
- Legacy Investment Requirements
- Minimum Data Requirements (Completeness) Lacking
- Multiple Tech Solutions Increase Challenge

Financial Management:

- Funding Responsibilities Unclear (Base-level)
- Funding Responsibilities Unclear (MAJCOM-level)
- GeoBase as Perceived Unfunded Mandate
  - Data Collection Funds Lacking
  - GeoBase Personnel Funding Lacking
  - Not Viewed as "Must Pay" by Other Organizations

Policy and Guidance:

- GeoBase PEC Not Clearly Defined
- Guidance Not Clear (Moving Target)
- Guidance Not Timely
- Lack Clear INFOSEC Guidance
- No Money, No Action
- Specific To-be Architecture Lacking

Reported Implementation Issues (cont)

Education and Training:

- AF In-house GeoBase Training Unavailable
- Customer Awareness of Capabilities/Benefits
- Large Learning Curve for Beginner Bases
- Personnel Retraining Requirement High
- Tech Solution Dependencies
- Training/Training Plan Not Current Priority
- Unified/Centralized Training/Training Plan Lacking

People and Workflow:

- Base-level GIO Required
- Centralized Efforts Lacking
- Hiring Pool Lacks Experts
- Info Collection and Maintenance Process Not Clear
- Insufficient GeoBase Personnel
- Key Players Not Under Same Chain of Command
- Military, Civilian, and Contractor Stereotypes
- Organizational Position/Reporting Chain of Base-GIO
- Poor Personnel Continuity
- Qualified Military Personnel Lacking
- Tasks Personnel Dependent

Information Architecture:

- Data Accuracy
- Data Sharing Across Firewall
- Data-refresh Requirements Not Clear
- Standardized Data Sets Lacking
  - Definitions
  - Minimum Requirements (Completeness)
  - Nomenclature

Reported Implementation Issues (cont)

Other:

- Communication
  - Change Management Practices
  - Coordination with Functional Communities
- Leadership:
  - Directiveness (Top-down vs Bottom-up)
  - Management Styles (Micro vs Macromanagement)
  - Program Champion Present (Yes or No)
- Scope of GeoBase Involvement
  - Number of GeoBase Programs Managed
  - Number of Implementation Sites Within Command

Appendix G. Detailed Information Resource Management Dimensional Categories

The list of potentially key IRM dimensions listed below comes directly from the work of Lewis, Snyder, and Rainer (1995). For those items which were found not to be key with respect to this research, the dimension has been struck through. Items represented in only a small portion of the sampled material yet retained as key are listed in italics. Each dimension in either of these aforementioned categories was discussed further in the results.

IRM Dimensional Categories	Lewis et al (1995)	Davies (1987)	Guimaraes (1988)	Lytle (1988)	Owen (1989)	Trauth (1989)	O'Brien and Morgan (1991)	Feeny and Willcocks (1998)
	IRM Literature from Academia							
Chief Information Officer:	✓	✓			✓	✓	✓	✓
• ~~CIO Approves Corporate-wide IS&T Acquisitions~~	✓	✓			✓			—
• CIO Responsible for Distributed IS&T	✓	✓			✓		✓	✓
• CIO Responsible for Corporate-wide IS&T Policy	✓	✓			✓		✓	✓
• CIO Involved in Corporate Business Planning Process	✓				✓	✓	✓	✓
Planning:	✓	✓	✓	✓	✓	✓	✓	✓
• *IS/T Plan Incorporates Central, Distributed and Desktop*	✓	✓						
• *Planning Process for IS&T Incorporates End Users*	✓	✓				✓	✓	
• ~~Users Support Distributed IT Facilities~~	✓							
• Plan for Corporate-wide IS&T	✓	✓	✓	✓	✓	✓	✓	
• *Formal Support for End-user Computing*	✓					✓		
• Training Programs for End-users	✓	✓		✓		✓		
• IS/T Plan Reflects Business Goals	✓	✓		✓	✓		✓	✓
• Assessment of Potential for New Technologies	✓	✓					✓	✓

IRM Dimensional Categories	**IRM Literature from Academia**							
	Lewis et al (1995)	Davies (1987)	Guimaraes (1988)	Lytle (1988)	Owen (1989)	Trauth (1989)	O'Brien and Morgan (1991)	Feeny and Willcocks (1998)
Security:	✓	✓	✓		✓		✓	
• Access Control Security	✓	✓			✓		✓	
• Data Security	✓	✓			✓		✓	
• *Security Awareness Program*	✓	✓						
• *Business Continuity/Disaster Recovery Plan*	✓	✓						
Technology Integration:	✓	✓	✓	✓	✓	✓	✓	✓
• Distributed Facilities	✓	✓					✓	✓
• *Office Automation Capabilities*	✓	✓			✓		✓	
• Communication Integration	✓	✓	✓	✓	✓		✓	
• Network Integration	✓	✓		✓			✓	
• IT Integration	✓	✓		✓	✓		✓	

IRM Dimensional Categories	**IRM Literature from Academia**							
	Lewis et al (1995)	Davies (1987)	Guimaraes (1988)	Lytle (1988)	Owen (1989)	Trauth (1989)	O'Brien and Morgan (1991)	Feeny and Willcocks (1998)
Advisory Committees:	✓				✓		✓	
• *IS&T Advisory/Oversight Committee(s)*	✓				✓		✓	
• *Senior Management Participates in Advisory Committees*	✓				✓		✓	
• *Users Participate in Advisory Committees*	✓						✓	
Enterprise Model:	✓	✓		✓	✓	✓	✓	
• *Data Communications between Central and Distributed Facilities*	✓	✓						✓
• *Inventory of Company IT Facilities*	✓							
• Formal Methodology for Systems Development	✓	✓	✓	✓	✓		✓	
• Inventory of Corporate Data and Information	✓				✓	✓		
• Standards for Distributed IS&T	✓	✓		✓	✓		✓	✓
• Documentation for Corporate-wide Information Flow	✓							
• ~~Use of Automated Development Tools~~	✓		✓					
• Corporate-wide Adherence to IS&T Standards	✓	✓		✓	✓		✓	

IRM Dimensional Categories	**IRM Literature from Academia**							
	Lewis et al (1995)	Davies (1987)	Guimaraes (1988)	Lytle (1988)	Owen (1989)	Trauth (1989)	O'Brien and Morgan (1991)	Feeny and Willcocks (1998)
Information Integration:	✓	✓		✓	✓	✓		
• Application Systems Integration	✓	✓						
• Data Integration between Applications	✓	✓				✓		
• Data Shared between Users and Departments	✓	✓				✓		
Data Administration:	✓	✓	✓	✓		✓	✓	
• Data Administration	✓	✓	✓	✓		✓	✓	
• Corporate Data Architecture	✓	✓		✓		✓	✓	
• Quality Assurance Program for IS and Facilities	✓		✓					✓
• Data Dictionary	✓	✓		✓				

IRM Dimensional Categories	Clinger-Cohen Act (1996)	44USC3506	OMB A-130 No. 4 (2000)	AF-CIO Focus Areas	AFFIRM Survey (2001)	AF Information Strategy (2002)	Benjamin et al (1985)	Stephens et al (1992)
	CIO Literature and Federal Documents							
Chief Information Officer:	✓	✓	✓	✓	✓	✓	✓	✓
• ~~CIO Approves Corporate-wide IS&T Acquisitions~~	—						✓	✓
• CIO Responsible for Distributed IS&T	✓	✓	✓	✓			✓	✓
• CIO Responsible for Corporate-wide IS&T Policy			✓	✓			✓	✓
• CIO Involved in Corporate Business Planning Process			✓	✓			✓	✓
Planning:	✓	✓	✓	✓		✓	✓	✓
• *IS/T Plan Incorporates Central, Distributed and Desktop*							✓	
• *Planning Process for IS&T Incorporates End Users*								
• ~~Users Support Distributed IT Facilities~~								
• Plan for Corporate-wide IS&T		✓		✓	✓	✓	✓	
• *Formal Support for End-user Computing*							✓	
• Training Programs for End-users				✓	✓		✓	✓
• IS/T Plan Reflects Business Goals	✓	✓	✓	✓	✓		✓	✓
• Assessment of Potential for New Technologies	✓		✓	✓		✓	✓	✓

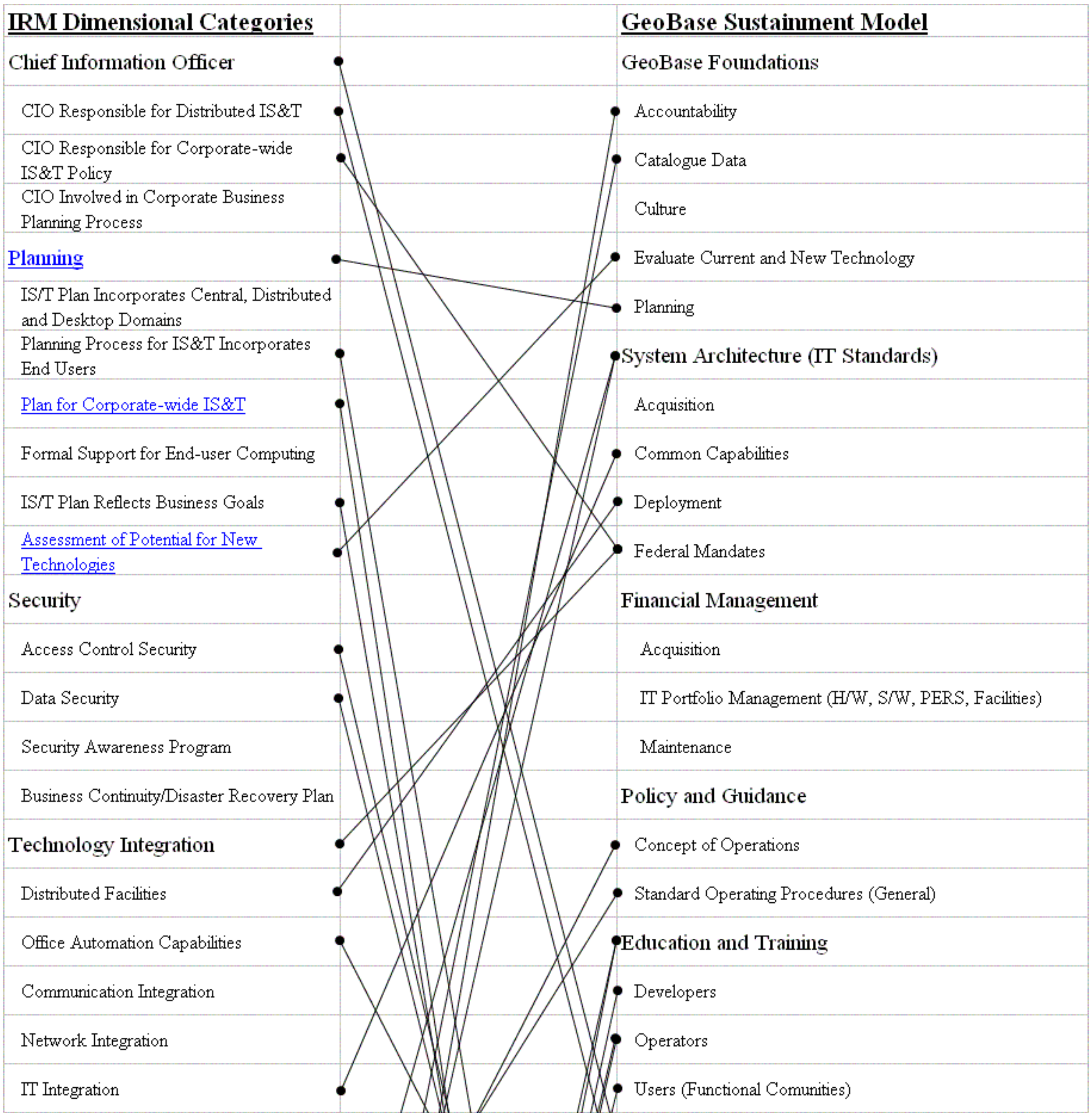
IRM Dimensional Categories	**CIO Literature and Federal Documents**							
	Clinger-Cohen Act (1996)	44USC3506	OMB A-130 No. 4 (2000)	AF-CIO Focus Areas	AFFIRM Survey (2001)	AF Information Strategy (2002)	Benjamin et al (1985)	Stephens et al (1992)
Security:	✓	✓	✓	✓	✓	✓	✓	
• Access Control Security		✓	✓		✓	✓	✓	
• Data Security		✓	✓		✓	✓		
• *Security Awareness Program*					✓			
• *Business Continuity/Disaster Recovery Plan*			✓		✓			
Technology Integration:					✓	✓	✓	✓
• Distributed Facilities						✓		
• *Office Automation Capabilities*								
• Communication Integration					✓	✓		
• Network Integration					✓	✓		
• IT Integration				✓	✓	✓		

IRM Dimensional Categories	CIO Literature and Federal Documents							
	Clinger-Cohen Act (1996)	44USC3506	OMB A-130 No. 4 (2000)	AF-CIO Focus Areas	AFFIRM Survey (2001)	AF Information Strategy (2002)	Benjamin et al (1985)	Stephens et al (1992)
Advisory Committees:				✓		✓		
• *IS&T Advisory/Oversight Committee(s)*				✓		✓		
• *Senior Management Participates in Advisory Committees*				✓		✓		
• *Users Participate in Advisory Committees*						✓		
Enterprise Model:			✓		✓	✓	✓	✓
• *Data Communications between Central and Distributed Facilities*						✓		
• *Inventory of Company IT Facilities*		✓	✓					
• Formal Methodology for Systems Development			✓					
• Inventory of Corporate Data and Information		✓	✓		✓			
• Standards for Distributed IS&T		✓	✓	✓	✓	✓	✓	✓
• Documentation for Corporate-wide Information Flow			✓		✓	✓	✓	
~~• Use of Automated Development Tools~~								
• Corporate-wide Adherence to IS&T Standards		✓	✓		✓	✓		

IRM Dimensional Categories	CIO Literature and Federal Documents							
	Clinger-Cohen Act (1996)	44USC3506	OMB A-130 No. 4 (2000)	AF-CIO Focus Areas	AFFIRM Survey (2001)	AF Information Strategy (2002)	Benjamin et al (1985)	Stephens et al (1992)
Information Integration:			✓		✓	✓		✓
• Application Systems Integration			✓		✓	✓		
• Data Integration between Applications			✓		✓	✓		
• Data Shared between Users and Departments			✓		✓	✓		
Data Administration:		✓	✓		✓	✓	✓	✓
• Data Administration		✓	✓		✓	✓	✓	
• Corporate Data Architecture			✓			✓	✓	
• Quality Assurance Program for IS and Facilities		✓						
• Data Dictionary			✓			✓		

Appendix H. Information Resource Management and GeoBase Sustainment Model Comparison

The following figure represents the qualitative content mapping technique used in the content analysis of the GSM with respect to the key IRM dimensions identified in this research. Where an IRM dimension matches a GSM concept, a line connects the two. Underlined text indicates an explicit match. Italic text denotes a concept not explicitly in the GSM but part of GeoBase (guidance).


IRM Dimensional Categories
Chief Information Officer
CIO Responsible for Distributed IS&T
CIO Responsible for Corporate-wide IS&T Policy
CIO Involved in Corporate Business Planning Process
Planning
IS/T Plan Incorporates Central, Distributed and Desktop Domains
Planning Process for IS&T Incorporates End Users
Plan for Corporate-wide IS&T
Formal Support for End-user Computing
IS/T Plan Reflects Business Goals
Assessment of Potential for New Technologies
Security
Access Control Security
Data Security
Security Awareness Program
Business Continuity/Disaster Recovery Plan
Technology Integration
Distributed Facilities
Office Automation Capabilities
Communication Integration
Network Integration
IT Integration
GeoBase Sustainment Model
GeoBase Foundations
Accountability
Catalogue Data
Culture
Evaluate Current and New Technology
Planning
System Architecture (IT Standards)
Acquisition
Common Capabilities
Deployment
Federal Mandates
Financial Management
Acquisition
IT Portfolio Management (H/W, S/W, PERS, Facilities)
Maintenance
Policy and Guidance
Concept of Operations
Standard Operating Procedures (General)
Education and Training
Developers
Operators
Users (Functional Comunities)


IRM Dimensional Categories (cont.)
Advisory Committees
IS&T Advisory/Oversight Committee(s)
Senior Management Participates in Advisory Committees
Users Participate in Advisory Committees
Enterprise Model
Data Communications between Central and Distributed Facilities
Inventory of Company IT Facilities
Formal Methodology for Systems Development
Inventory of Corporate Data and Information
Standards for Distributed IS&T
Documentation for Corporate-wide Information Flow
Corporate-wide Adherence to IS&T Standards
Information Integration
Application Systems Integration
Data Integration between Applications
Data Shared between Users and Departments
Data Administration
Data Administration
Corporate Data Architecture
Quality Assurance Program for IS and Facilities
Data Dictionary
Education and Training
User Training
IRM PERS Education and Training
Leadership Education
GeoBase Sustainment Model (cont.)
People and Workflow
GeoBase Information Officer
HRM
Organization
Roles and Responsibilities
Business Process Mapping
Functional Communication/Assistance
Information Architecture
Standards
Applications
Data
Imagery
Metadata
Inventory
INFOSEC
GeoBase Strategy
Cultural/Technological Integration
Federalistic Management
Functional Coordination
GeoBase Mission
Better Decision Making
Enable Information Sharing
Enterprise-wide (USAF)
Integrate Information

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14. ABSTRACT
Billions of dollars have been wasted on failed information system (IS) projects over the last decade. More specifically, the US military has not implemented a single successful geospatial IS (GIS). A lack of a service-wide insertion process for GIS was cited as the most significant cause for military-GIS failures. GeoBase represents the USAF's most recent GIS implementation. The GeoBase program uses the GeoBase Sustainment Model (GSM) as an insertion tool for implementation success.
Within the Federal government, stricter control on IS has been established in an effort to increase the rate of IS project success. Information resource management (IRM) has been offered as the solution.
The researcher conducted a case study investigation of GeoBase implementation issues as perceived at the USAF-MAJCOM level in order to qualitatively assess the validity of the anecdotally constructed GSM. In addition, the researcher assessed the model against key IRM dimensions. The model adequately represented the reported implementation issues and the IRM dimensions. However, the model was underspecified. Inclusion of communication, a category of reported implementation issues, and advisory committees, a major IRM dimension, would more fully specify the model. A fully specified model may act as the service-wide GIS insertion model, which is currently lacking.

15. SUBJECT TERMS
Case study; information system implementation; geographic information system; geospatial information system; information resource management; GeoBase; GeoBase Sustainment Model

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