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Joining the Department of Defense Enterprise Resource Planning Team: The Air Force's Role in the Enterprise

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JOINING THE DEPARTMENT OF DEFENSE ENTERPRISE RESOURCE PLANNING TEAM: THE AIR FORCE'S ROLE IN THE ENTERPRISE

THESIS

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Abstract

Over time, the Air Force (AF) built customized legacy logistics data and information systems, which have evolved into an inflexible network of obsolete systems that are costly to maintain and upgrade, and struggle to share data in a timely and coherent manner. The Department of Defense (DoD), to include the Defense Logistics Agency (DLA), the US AF, the US Army, and the US Navy, have all recognized the need to modernize and integrate their legacy systems to improve warfighter support. The DLA, the US Army, and the US Navy all see Enterprise Resource Planning (ERP) technology as a commercial best practice, and consequently as the best way to replace their legacy systems. They are all in the process of implementing ERP pilot tests. The AF has adopted a 'watch and learn' position on ERP, while continuing to upgrade its legacy systems piecemeal.

This thesis first seeks to understand what ERP is and how it is being used. A case study analysis of the DLA, the US Army, and the US Navy ERP pilot tests is used to explore how and why the DoD organizations are using ERP, and to see if it is time for the AF to formally explore ERP technology to replace its legacy logistics systems.

JOINING THE DEPARTMENT OF DEFENSE ENTERPRISE RESOURCE PLANNING TEAM: THE AIR FORCE'S ROLE IN THE ENTERPRISE

I. Introduction

Background

Businesses and government agencies all over the world have made the decision to implement an Enterprise Resource Planning (ERP) system to integrate and manage their business functions. Davenport characterized ERP as "the most important development in the corporate use of IT in the 1990s" (Robey, Ross and Boudreau, 2002). ERP systems consist of complex software that attempts to integrate and automate the business processes of all departments and functions across a company onto a single computer system that can serve all those different departments' particular needs by tracking and recording every business transaction input from anywhere in the organization (Koch, 2002; Minahan, 1998; Palaniswamy and Frank, 2002). ERP's possible benefits are very enticing, but implementing ERP is an expensive, time consuming, and risky proposition, that requires extensive planning and top-level support to avoid failure.

Overtime, government agencies have built thousands of interlinking systems that have resulted in inflexible, outdated, and expensive networks that struggle to keep up with the changing warfighter demands. There is definite interest in ERP technology within the Department of Defense as a way to modernize and integrate systems in a more cost effective and flexible manner. The Defense Logistics Agency (DLA), the US Army,

and the US Navy are currently testing ERP pilots. The US Air Force is in the process of investigating various ways to modernize its systems.

Problem Statement

AF legacy systems labor to work together to extract useful and accurate information to analyze trends and make decisions. Various AF policies and numerous initiatives recognize the importance of modernizing the AF's costly and inflexible disparate legacy data and information systems to enhance warfighter support, but there are no official plans to better integrate the systems. As the DLA and the other Services are move forward to test ERP pilots, the AF's official position concerning ERP remains 'wait and see,' or 'watch and learn.' Some fear the AF is falling behind in the IT arena and will be the weak link in the next war.

Research Question

The purpose of this research is to determine "Is it time for the AF to explore and test commercially available ERP solutions to modernize and integrate its information and data systems?"

Investigative Questions

To answer the overall research question, ERP is defined and explored by answering the following investigative questions:

1. What is ERP?
2. What is the AF's official position regarding ERP?
3. Why is the AF taking that position regarding ERP?

4. What are other government and military organizations doing regarding ERP?
5. Why are the DLA, the US Army, and the US Navy using ERP?
6. If the AF chooses to explore ERP technology, where is the logical place to test ERP?

Research Objective

This research attempts to pull vast amounts of ERP data into one document to understand what ERP is and how it is being used in commercial, government, and military environments. It explores how and why the DLA, the US Army, and the US Navy are using ERP, and attempts to understand the AF's position regarding ERP technology.

Scope and Limitations of the Research

Most of the information and data collected for this research comes from literature and interviews. There is limited literature related to the AF's position and efforts concerning ERP. The interviews were limited to AF informants and involve second-hand knowledge, and personal opinions. The case studies are limited to the experiences from only three other military-type ERP implementations. The organizations studied are still in the early phases of implementing and testing ERP, so the conclusions drawn from their preliminary results could be premature. Only time will tell if the various pilots succeed or fail.

Methodology

This research uses a case study methodology to gather data concerning ERP uses in government and military organizations. Relevant literature was reviewed to gain a better understanding of what ERP is. Literature and interviews helped to understand what the AF, the DLA, and other Services are doing regarding ERP.

A review of related literature will be used to get a background in how ERP evolved, to examine various ERP vendors, to understand ERP's costs, benefits, capabilities, and challenges, and to gain perspective from different government and military ERP case studies. Interviews with AF members will help gain an insight into where the AF currently stands regarding ERP and what efforts, if any, it has undertaken to explore or test ERP technology.

Summary

This chapter discussed the background, the problem, the research questions, the research objective, and the methodology used in this thesis. Chapter Two will review the relevant literature to understand what ERP is, and what the DLA, and other Services are doing regarding ERP. The qualitative methodology used to explore the research questions is explained in Chapter Three. Chapter Four presents the analysis, findings, and recommendations based on the research data. Finally, Chapter Five will cover the limitation of this research, and recommendations for future related research.

II. Literature Review

Introduction

This literature review is separated into two separate sections. The first part is a review of the literature related to the history and background of Enterprise Resource Planning (ERP). It is a compilation of literature gathered from the experiences of commercial businesses. The other section deals with the background and ERP experiences of the US AF, the DLA, US Army, and US Navy.

Definition

ERP is the newest and most advanced IT, and business management tool available to businesses all over the world. Davenport characterized ERP as "the most important development in the corporate use of IT in the 1990s" (Robey, Ross and Boudreau, 2002). ERP systems consist of complex software that attempts to integrate and automate the business processes of all departments and functions across a company onto a single computer system that can serve all those different departments' particular needs by tracking and recording every business transaction input from anywhere in the organization (Koch, 2002; Minahan, 1998; Palaniswamy and Frank, 2002).

This integrated, customized, packaged software system can handle the majority of an enterprise's system requirements in areas such as finance, human resources, planning of manufacturing, sales and marketing, and facilitates the flow of information across the enterprise due to its unique multi-dimensional data architecture and single common database (Davenport, 1998; Harrold, 2001; Kumar, Maheshwari and Kumar,

2002; "Scoopsoft…," 2002). The software comes as prepackaged modules (manufacturing, order entry, accounts receivable, accounts payable, general ledger, purchasing, warehousing, transportation, and human resources depending on the ERP provider) that can be arranged for individual companies, with customization options and interfaces with the organization's own software available ("ERP Overview," 2002). The prepackaged standardized software represents a significant change from the proprietary legacy software systems written over the years for each individual company, which required complex and expensive interfaces to achieve even rudimentary levels of integration (Teltumbde, 2000).

ERP technology was originally targeted at manufacturing companies, and is now the backbone for manufacturers providing more effective production scheduling, materials management, and logistics planning (Davenport, 2000; Kumar, Maheshwari and Kumar, 2002; Palaniswamy and Frank, 2000; Saccomano, 1998). Improved scheduling breaks down requirements and organizes them to keep manufacturing costs at a minimum, while maintaining service levels and controlling inventory (Rooney and Bangert, 2001). However, ERP is more than just an office automation tool to be bought off the shelf and installed. This particular IT solution is a process enabler and integrator that transforms business processes to utilize the best practices in the industry (Jenson and Johnson and Johnson, 1999; Palaniswamy and Frank, 2000). Earlier software systems were created to support status quo operations, but ERP means altering processes and shaping the organization to fit the software in order to reach ERP's 'promised land' of

benefits and competitive advantages (Harrold, 2001; Kumar, Maheshwari and Kumar, 2002).

All ERP systems have a three-tier architecture. The presentation layer is at the top, and provides the interface between the user and the system. This is the graphic user interface, or screens, that the workers use to input and access data in the system. The middle layer is similar to an electronic data interface or interchange responsible for exchanging, collecting, and disseminating information among the various databases as needed. Several companies, like Oracle, are relying on the Internet to replace the middle layer, which has led to higher scalability and better integration with customers and suppliers. The database lies in the bottom layer (Hernandez, 1997; Palaniswamy and Frank, 2002). This unique architecture means that companies can acquire a solution that puts less emphasis on functional silos, leading to a new class of user with a more effective decision support system by utilizing real-time integration, data analysis, and information flow. This creates a new paradigm for business simulation and optimization with increased importance of knowledge and computer-based technology connecting the supply chain faster and more accurately (Palaniswamy and Frank, 2000).

History

Companies have always struggled to manage inventory, schedule manufacturing, and plan requisitions more efficiently and effectively to save money and improve customer service. Before the advent of computers, experts in the warehouse and on the plant floor tracked everything on paper. In the 1960s, computers brought software customized to handle inventory based on traditional inventory concepts ("ERP

Overview," 2002). The 1970s shifted the focus to material requirement planning (MRP) systems that translated the master schedule built for end items into time-phased net requirements for sub-assemblies, components, and raw materials planning and procurement ("ERP Overview," 2002). Customer orders were still paper-based and traveled slowly from in-basket to in-basket, being rekeyed into standalone databases at each department (Koch, 2002). MRP evolved into MRP II in the 1980s, extending MRP to shop floor and distribution management activities ("ERP Overview," 2002). MRP II is a sequential technique used for converting the master production schedule into operation planning and demand management, creating a detailed schedule for components to be made in-house or purchased from vendors (Kumar, Maheshwari and Kumar, 2002; Palaniswamy and Frank, 2000).

The 1990s advanced computers allowed the extension of MRP II to cover and integrate areas like engineering, finance, human resources, and projects management with ERP, a term coined by the Gartner Group ("ERP Overview," 2002; Kumar, Maheshwari and Kumar, 2002).

ERP is the new generation of IT for businesses, especially those in the manufacturing market. MRP II still operated on proprietary midrange platforms, but ERP integrates data from all functional units in a relational database, has graphical user interfaces, uses fourth-generation languages, has client-server architecture, and open systems capabilities database to improve manufacturing performance (Kumar, Maheshwari and Kumar, 2002; Palaniswamy and Frank, 2000). With ERP, the customer service representative enters a customer order, and information through the entire system

is updated and linked automatically in real-time (financial information like payment, and credit rating, warehouse information like inventory levels, and orders placed, and logistics information like shipping schedule, and receipt schedule) (Koch, 2002).

The future of ERP is limitless. Every major manufacturing company is expected to purchase and install ERP software just to stay competitive ("ERP Overview," 2002). Smaller companies and other industries are also seeing the benefits of ERP, and are looking to more specialized ERP companies to provide them industry-specific ERP software. There is also growing emphasis on e-commerce which is leading some ERP providers to offer Internet/Web-based applications to link the business partners from multiple companies real-time to increase collaboration among supply chains ("ERP Overview," 2002).

Companies

Since the birth of ERP technology, the supplier marketplace has grown to match the needs of the various businesses interested in implementing the integrated software packages. The markets leaders are SAP, Oracle Corporation, PeopleSoft, Inc., JD Edwards and Company, and Baan International. Together, they account for 64 percent of total ERP market revenue ("ERP Overview," 2002; Jenson and Johnson, 1999).

SAP is considered to be the originator of ERP and still dominates 30 percent of the market. They prefer to offer products and services to larger firms, and are typically on the high end of the price scale (Palaniswamy and Frank, 2000). SAP offers over 40 different modules grouped into 5 areas: manufacturing, finance, human resources, project management, and information systems with licenses prices based on number of

simultaneous users that the system will support (Hitt, Wu, and Zhou, 2002). Oracle is the leader when it comes to Web-based network computing architecture (NCA) that replaces the middle layer of ERP with the Internet, and offers advantages like higher scalability and better coordination with suppliers and customers (Palaniswamy and Frank, 2000). Companies with plants dispersed all over the country or globe often chose Oracle because of the Internet-related applications that allow for more centralized decision-making. Global companies often pick Baan International because they offer modules that do a good job of linking monetary and technology requirements of various countries that the organization operates in (Palaniswamy and Frank, 2000). There is also a growing market for smaller, less expensive, more specialized ERP suppliers among small to mid-sized companies outside of the manufacturing industry. ERP consultants are also growing in popularity, and many companies credit their success to the impartial, knowledgeable third-party consultants they hired to ease their ERP process (Hitt, Wu and Zhou, 2002).

Cost

ERP has become increasingly popular over the last 10 years with about $300 billion being invested in ERP worldwide over the last decade. Licensing and maintenance revenues for the ERP market was $17.2 billion in 1998, and increased to $24.3 billion in 2000 with over 60 percent of multinational firms having adopted ERP technology. Sales are expected to continue to increase as smaller firms and different industries adopt ERP into their businesses (Bingi, 1999; Hitt, Wu, and Zhou, 2002; Palaniswamy and Frank, 2000; Ragowsky and Somers, 2002).

Choosing to implement an ERP solution is a costly proposition, but companies hope to recoup the costs through the process improvement benefits promised by ERP. There are varying numbers when it comes to the average cost of an ERP system, because it depends on the company chosen, the number of modules installed, the size of the company, the amount of customization, installation time, and follow on services to name a few of the variables, but $15 million came up most often as the average ERP cost (Hitt, Wu, and Zhou, 2002; Koch, 2002). The actual implementation phase is the most costly stage because it involves purchasing the software, buying incremental hardware, training users, and implementation support. Small companies with $10 million in annual sales typically spend around $200,000, mid-sized with $40 million to $70 million in annual sales can expect to spend $600,000 to $800,000, and larger companies will often spend several million dollars to implement ERP solutions (Ragowsky and Somers, 2002).

There are many hidden costs associated with ERP that companies need to be aware of when making the decision to go ahead with purchasing the software; training, integration and testing, customization, data conversion, data analysis, retaining employees, a fulltime ERP implementation team, waiting for promised returns on investment, and post-ERP depression are all typical costs not included in the original software estimate (Koch, 2002). Failing to consider these costs can cause the ERP implementation to fail, or cause the company to go bankrupt before the installation is complete.

Reasons for Choosing ERP

The reasons for choosing ERP are many and varied, but most managers understand that not implementing ERP would put them at a disadvantage within their industry (Teltumbde, 2000). Prior to 2000, the most common reasons for choosing ERP included Y2K compliance and the need to replace outdated legacy systems. Most companies chose to buy a new state-of-the-art computer solution than pay to fix problems with their old software platforms (Jenson and Johnson, 1999; Kumar, Maheshwari and Kumar, 2002; Robey, Ross and Boudreau, 2002). Legacy systems were built up over time as organizational needs arose, but it has led to process fragmentation along functional boundaries. Without integration, coordination and communication problems are common, especially as companies grow and merge, and are detrimental to the organization (Jenson and Johnson and Johnson, 1999; Palaniswamy and Frank, 2002; Robey, Ross and Boudreau, 2002). To combat the shortfalls of legacy systems, ERP is installed to centralize and reduce redundancies by standardizing and integrating data throughout the company ("ERP Overview," 2002; Hitt, Wu, and Zhou, 2000). In the past year, e-business and Web-based portals are making information flow even easier, especially across the supply chain (Apicella, 2001; Kumar, Maheshwari and Kumar, 2002). ERP is also often implemented as part of a process reengineering initiative. The software requires companies to alter their business processes to the architecture of the software, which is built around what the ERP providers see as industry best practices (Jenson and Johnson and Johnson, 1999; Robey, Ross and Boudreau, 2002). Finally, the push towards globalization, and the challenges associated with multiple currencies and

country-specific requirements make operations even more difficult to coordinate. ERP was designed to handle just this type of environment with its ability to integrate and centralize distributed transactions across various databases (Jenson and Johnson, 1999; Teltumbde, 2000). In the ever changing and increasingly complex marketplace, ERP helps companies stay competitive.

Studies show the top management initiates ERP adoption in about 74 percent of organizations (Kumar, Maheshwari and Kumar, 2002). They are faced with trying to find the most effective inventory levels to minimize stockouts, reduce carrying costs, and keep the production line running (Apicella, 2001; Rooney and Bangert, 2001). Integrating and automating the customer order process across the organization with ERP technology means that everyone in the company has the same information in real-time to analyze trends and make the best decisions for the entire enterprise (Koch, 2002).

ERP Stages and Criteria

Deciding to implement ERP, choosing the provider, implementing the technology, and finally using the system is an extended and expensive proposition, and it is imperative that it be done correctly or the entire process could result in a catastrophic failure. The literature on the subject is vast and varies slightly between different researchers, so the following is a compilation of numerous ideas. First, the overall process used in this paper comes from Kwon and Zmund's IT Implementation Model, Figure 1, as it was applied to SAP implementations with some slight modifications by Palaniswamy and Frank (2002).

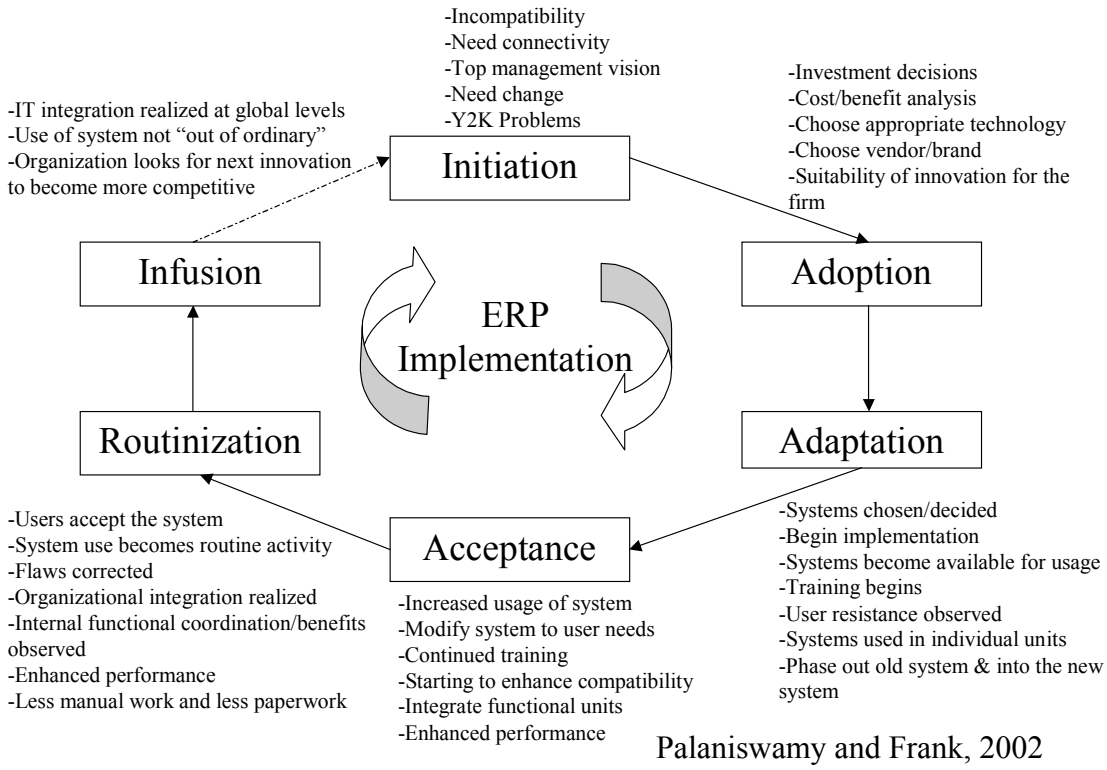


Figure 1. Information Technology Implementation Model

Initiation.

The first step in the model is to initiate the process based on the companies needs. The company should form a team of managers and key employees to create objectives, research, and choose an ERP system. The ERP team needs to continue to help with the training and adjustment aspects of the project (Jenson and Johnson, 1999). This is also a good time for the team to map the current state of operations. Each process is evaluated and blueprinted to understand the steps involved, the links between the different areas, and the flow of information and parts through and across the business. As discussed earlier, each company has different needs and requirements, so management and the ERP team must carefully consider the choice of an ERP system.

Adoption.

The next step in the implementation process is adoption where the ERP consultant, vendor, and software are handpicked to ensure the best fit for a successful initiative. Based on lists of criteria from several authors, the following appear to be the most important for success.

Choosing an ERP consultant and vendor are crucial to the success of the project, because they provide the link between the company needs and software capabilities, as well as the support needed to get the system up and running. ERP consultants should have a reputation in the industry for successful ERP implementations and a good working attitude. They need to have a relatively high level of experience with ERP to understand the right way to successfully choose, implement, and support ERP projects. Process engineering experience is also a plus, because ERP projects usually lead to extensive reengineering of business processes to fit the software. Industry knowledge is also vital, because each ERP system is typically built for a specific industry and knowledge of what industry needs and what ERP software can provide is important. Consultants also need to have a methodology, or approach, that meshes with the way the company works. This needs to be discussed in the preliminary interview process to ensure compatibility between the consultant and company. Finally, cost is definitely a factor in choosing a consultant. ERP projects are expensive undertakings. It is important to get a good consultant, but not one that will strain the budget to a breaking point (Kumar, Maheshwari and Kumar, 2002). Important vendor credentials are much the same as for the ERP consultant, with the added criteria of longevity. The ERP vendor must be well

established, have a stellar reputation, and have the infrastructure to support the company well after implementation. Software upgrades and follow-on support are necessary in any ERP project, so it is vital that the vendor will be there to provide that support after implementation (Teltumbde, 2000).

After reviewing and compiling the data from various sources, twelve criteria for choosing the right ERP software emerged.

1. Cost: Cost is a definite consideration for any company choosing to implement a new ERP system. The most important thing to remember about cost is to look at the total cost, not just the price of the software package. This is where many companies that fail to take in all the costs of an ERP system will run into budget breaking overruns that could threaten a successful implementation. Total cost includes the license, training, implementation, maintenance, amount of customization, and hardware requirements. Comparisons of the different ERP providers to each other on the basis of total cost allows companies to choose the providers that meets requirements for the lowest cost of ownership (Kumar, Maheshwari and Kumar, 2002; Teltumbde, 2000).

2. Technology: The ERP technology, to include the supporting hardware, must be the most advanced and remain flexible to future expansions and upgrades. The planning process must take into account that the ERP system needs to be able to support the business though out its lifetime, beyond current needs. The best advice is to purchase as much commercial-of-the-shelf (COTS) software as possible, and avoid customizing the ERP system so that future upgrades are easier and cheaper (Kumar, Maheshwari and Kumar, 2002; Teltumbde, 2000).

3. Benefits: It would seem to be common sense to look at the benefits that an ERP system can bring to an organization, but the benefits need to be

important to the company and contribute positively to the business strategy. ERP systems incorporate available best business practices in their design, so companies automatically get those benefits if they can adapt to take advantage of them. Comparisons of different ERP systems' benefits, to include second-order effects and the time to realize those benefits, can aid in choosing the right system (Kumar, Maheshwari and Kumar, 2002; Teltumbde, 2000).

4. Fit with Business Strategy: Each company has different business strategies, and the ERP system must fit and aid those strategies. ERP systems work especially well with companies that operate in a low cost environment, that need to remain flexible in a rapidly changing marketplace, and those that are information and knowledge intense. Another consideration is to maintain fit with parent and allied organizational systems and strategies after implementing a new ERP system (Kumar, Maheshwari and Kumar, 2002; Teltumbde, 2000).

5. Ease and Length of Implementation: Another important consideration in choosing the right ERP system is the implementation time and ease. Implementation can take months or years, depending on the size of the organization and the extent of the ERP system. Most companies would prefer to keep the implementation time to a minimum, because it can disrupt normal operations and it takes that much longer to realize the benefits of ERP (Teltumbde, 2000).

6. Amount of Change Required: There will always be a certain amount of change required when implementing an ERP system. ERP systems operate using best practices, integrate functions, and introduce new technology to an organization. Companies realize 80 percent of ERP benefits by changing the way they do business by conforming processes to fit the ERP system (Kumar, Maheshwari and Kumar, 2002; Teltumbde, 2000). There is a risk of impairing the conceptual foundation of the enterprise if the change in the business model is too drastic (Teltumbde, 2000). There is no one perfect ERP system that fits every

business, so it is important to find the ERP software that is most compatible with the company's way of doing business.

7. Amount of Customization: Under the criteria of customization, there are two sides. On one hand, companies want to keep customization to a minimum so future upgrades are easier and less expensive. Finding an ERP system that fits the company's needs with the least amount of customization is vital (Teltumbde, 2000). If some level of customization is unavoidable, it is important choose an ERP provider that makes customization simple (Kumar, Maheshwari and Kumar, 2002).

8. Functionality: ERP system functionality is also important to consider. The ability to consolidate knowledge among various functions and sites is important to maintain control of broad organizations. Businesses are often spread between multiple sites and even different countries, so the right system needs to be able to support the processes and data needs of a company within its industry and through out the different countries if necessary (Kumar, Maheshwari and Kumar, 2002; Teltumbde, 2000).

9. Amount of Risk: Risk is always present when implementing an ERP system. At least 90 percent of all implementations run late or over budget, so thorough research into the different competing ERP systems to find the best fit, total cost, benefits, etc. is very important to the success of the project (Teltumbde, 2000).

10. Ability to Integrate: A good ERP system must also be able to integrate the processes and functions of a company. Every company offers different modules specific to the various processes companies perform. There needs to be seamless integration between the modules, and an ability to integrate homegrown systems with the ERP modules if the company chooses. (Shankarnarayanan, 1999; Teltumbde, 2000).

11. Ease of Use: ERP systems are inherently complex, but the users should find the system easy to use. If users find the system difficult to understand and use in day-to-day operations, they will balk against the change. The user interface needs to be very user friendly (Teltumbde, 2000).

12. Reliability: Finally, the system needs to be very reliable. ERP systems are responsible for large quantities of data, integrating processes, and keeping the company running efficiently and effectively, so it is vital that the software and hardware be as reliable as possible (Kumar, Maheshwari and Kumar, 2002).

Adaptation.

After evaluating the different ERP systems on the market, the ERP team makes a recommendation to top management about which ERP system fits the criteria best (Teltumbde, 2000). After choosing the ERP system, adaptation is the third stage in ERP implementation process. The actual implementation of the ERP hardware and software begins, and personnel training starts after configuring the system to meet company needs. The old information systems are phased out as the new ERP system is phased in (Kwon and Zmund, 1987).

Reengineering is usually unavoidable when implementing an ERP system (Jenson and Johnson, 1999). This is a good time to identify some areas of weakness and opportunities for process improvement (Jenson and Johnson, 1999). Through gap analysis, discrepancies between current procedures and ERP processes are identified and changes are planned. If there is a task that ERP does not address, a workaround must be found (Jenson and Johnson, 1999). Then the new processes are designed and scripted through an iterative process. The steps and screens necessary to access the data fields are

configured and laid out. This is where the majority of the actual computer system is configured to address the companies' needs. Once the databases are mapped, the actual data files need to be transferred from the legacy systems into the new ERP system (Jenson and Johnson, 1999). This is usually time intensive and tedious, but needs to be accomplished before the system can be used. Finally, the system is tested through simulation before the final system goes live (Jenson and Johnson, 1999). There are three implementation strategies for the go live phase. Most companies, 69 percent, choose to phase the new ERP system in by modules. Another 25 percent phase the new system in by business unit, site, or plant. The least used strategy is the big bang, where the entire ERP system is rolled out at the same time (Kumar, Maheshwari and Kumar, 2002). Systems are usually phased in to accommodate and facilitate training. One of the most important aspects of implementing a successful ERP system is to keep personnel resistance to change at a minimum. The best way to do this is to provide useful training through methods like meetings, seminars, demonstrations, and follow-up surveys that not only provides instruction on how to use the system, but training that explains and stresses why the transition to the new ERP system is necessary. If employees understand how the system works and how it will improve the company, the transition usually goes more smoothly.

Acceptance.

As the new system is phased in, initial resistance gives way to tentative acceptance. The various ERP modules are integrated and the system can be modified to meet user needs. Training continues to help users understand how their portion links

with the other functional areas of the company. More workers can be trained to use the system, and contractor or vendor system support can start to recede as the skills and knowledge of the new technology improves. The using company should start to see some evidence of enhanced performance as the ERP system starts to do its job.

Routinization and Infustion.

The last two steps in the ERP implementation model occur as the company gets more comfortable with their ERP system as they use it every day to conduct business operations. First, the use of the system becomes routine (Kwon and Zmund, 1987). Users fully accept the system and find it vital to perform day-to-day operations. Most of the flaws in the system have been worked out, and processes are integrated. The amount of manual work and paperwork decrease as operations become integrated by the computer system. This is important to continually evaluate the system to ensure it actually performs to the expectations set at the beginning of the process and continues to meet needs. It is best to catch discrepancies early so they can be corrected before they manifest in the system and are set in the users' processes (Teltumbde, 2000). The last step is infusion. The ERP system is fully used by the organization to integrate processes, units, and locations. The company relies on the technology completely. They have become as effective and efficient as they can with the current system and start to look for the next innovation to remain competitive (Kwon and Zmund, 1987).

Benefits

The overall goal of nearly every company is to increase customer service while saving money. Successfully installing ERP can provide many advantages to help

companies reach their goals. The ability to integrate business functions to enhance cooperation and communication, enhancing decision making for employees and managers at every level, and introducing best business practices into core business processes more effectively and efficiently than any other IT system to date is why many of the top companies are choosing to implement powerful ERP systems (Jenson and Johnson, 1999).

Numerous authors, researchers, and companies cite the ability to integrate the various separate functions of a company within one system as a foundation of ERP (Hitt, Wu and Zhou, 2002; Jenson and Johnson, 1999; Kumar, Maheshwari and Kumar, 2002; Palaniswamy and Frank, 2000; Robey, Ross and Boudreau, 2002; "Scoopsoft…," 2002; Teltumbde, 2000). ERP vendors can replace most legacy systems with a single, integrated information system consisting of provide proven and reliable software with follow-on support and upgrades for longevity (Jenson and Johnson, 1999; Teltumbde, 2000). Integration means that information put in at one point in the system automatically updates databases in other areas of the system without the complex and expensive interfaces necessary with legacy computer systems (Teltumbde, 2000). ERP also standardizes business processes across functional areas, while decreasing the emphasis on functional silos (Hitt, Wu and Zhou, 2002; Kumar, Maheshwari and Kumar, 2002; Palaniswamy and Frank, 2000). Integration seamlessly enhances cross-functional relationships and cooperation between divisions, leading to increased productivity and manufacturing performance (Legare, 2002; Palaniswamy and Frank, 2000). The ability to link operations is across different countries and even between supply chain members

only works to improve a company's competitiveness (Jenson and Johnson, 1999; Palaniswamy and Frank, 2000).

Integration with ERP also improves the quality of the data flowing through the company (Kumar, Maheshwari and Kumar, 2002). The data is entered once, eliminating redundant data entry and the resulting errors, and automatically interacts with other modules for improved, real-time data accuracy (Kumar, Maheshwari and Kumar, 2002; "Scoopsoft…," 2002). The data is standardized so orders can be tracked, fulfilled, and the financial aspects managed easier than with legacy systems (Robey, Ross and Boudreau, 2002). More accurate data flows quickly through the company to enhance decision-making and performance.

The real-time, accurate information available with an ERP system also leads to better worker and managerial decision-making (Hitt, Wu, and Zhou, 2002; Robey, Ross and Boudreau, 2002). Workers have access to more information, which leads to an enhanced understanding of what is happening throughout the entire enterprise (Hitt, Wu, and Zhou, 2002). This new class of user is present in companies with ERP at every level, and they are less stove piped and more process-centered (Palaniswamy and Frank, 2000; Robey, Ross and Boudreau, 2002). For management, being able to centralize knowledge in real-time means better decisions for the entire company (Robey, Ross and Boudreau, 2002). It is also easier to analyze data trends, run simulations, and plan to optimize all aspects of the business (Palaniswamy and Frank, 2000; Robey, Ross and Boudreau, 2002).

Finally, ERP brings industry best practices into the organization due to the software architecture ("Scoopsoft…," 2002). Companies implementing ERP transform inefficient or outdated business processes supported with legacy systems to accepted best practices fully supported and even demanded by ERP (Hitt, Wu and Zhou, 2002). The transformation procedure may not be an easy process for the organization, but the expected benefits of improving the processes to make the organization more efficient and effective in the marketplace typically outweigh the hardships (Robey, Ross and Boudreau, 2002; Teltumbde, 2000).

Company metrics should improve across the board after the adjustment period. Inventory typically decreases with the ability to analyze and plan better from the top on down (Jenson and Johnson, 1999; Kumar, Maheshwari and Kumar, 2002). Inventory costs should also drop by 20 percent to 40 percent as excess inventory carrying costs are reduced (Gossard, 1998; Ragowsky and Somers, 2002). Cost savings generated from carrying less inventory and reduced systems maintenance translate into decreased cost of customer service (Hitt, Wu and Zhou, 2002). Money saved during processes can immediately be used to further improve the organization, unlike increased profits that are more uncertain and take longer to realize the benefit. Other metrics like cycle time, on-time deliveries, and financial closing times should also show improvements with ERP (Jenson and Johnson, 1999). Some benefits of ERP can be hard to measure because they are intangible, but if ERP is implemented successfully the company typically sees improvements in nearly every aspect of measurable performance.

Challenges

ERP systems can offer companies great benefits when successful, but implementations fail more often than not (Legare, 2002). There are always risks when making any change in an organization, especially when it involves IT. ERP requires intense planning, sweeping change, personnel adjustment, and large investments of money and time. Implementing ERP is not easy and can fail if not planned for or executed properly. There are also possible hazards in using the system, because the ability to link the entire organization with one information system can ruin the organization as easily as it can improve it if the data is faulty, the architecture is wrong, or the system malfunctions. ERP is a significant undertaking, it involves more than just upgrading an IT system (Manoeuvre, 2001). It is a major business project that will require extensive planning and top-level support to avoid possible problems.

Problems in the planning process are one of the most common pitfalls of ERP systems. Seventy percent of ERP implementations fail to achieve corporate goals or expectations (Kumar, Maheshwari and Kumar, 2002). Not assigning the best people from the organization to the ERP planning and implementation team is a mistake (Manoeuvre, 2001). The project will take most of their time and take them away from their current jobs, but implementing ERP is a one time opportunity to reshape and streamline the business, so it needs to be done right. If the team does not totally understand the impacts of an ERP system or fails to take all the requirements of the organization into account during the planning process, the ERP system that they choose will not fit the organization and not meet expectations (Ragowsky and Somers, 2002).

Many times, ERP systems fail because the software cannot handle the sheer volume of transactions due to poor planning (Jenson and Johnson, 1999). Investing in ERP is a major commitment, so it is vital that the planning process be in depth and extensive to understanding organization needs, what ERP can offer, and prepare in advance to avoid problems during implementation and rollout (Manoeuvre, 2001). In the end, the company must choose the right software and system to meet its specific needs, and this only happens if the planning process is done correctly (Koch, 2002).

ERP systems are also inherently complex and often require sweeping changes in the organization to realize the benefits. The sophistication of ERP means that much cooperation is necessary when planning for and implementing the system (Legare, 2002; Manoeuvre, 2001; Robey, Ross and Boudreau, 2002). It affects every aspect of the business and every person in the organization, often requiring organizational structure and process changes. Many ERP implementations fail because companies opt to customizing the software to support status quo operations instead of adapting to fit ERP's integrated architecture (Jenson and Johnson, 1999; Robey, Ross and Boudreau, 2002). The other problem is not managing the organization change effectively (Manoeuvre, 2001). ERP will change power structures, personnel roles, and required job skills so it is imperative that the organization and personnel are prepared and able to embrace the different processes under the new system (Manoeuvre, 2001). Resistance to change can easily lead to system failure. Allied Waste Industries purchased SAP America had to discontinue implementation when the complexity and expense of the system outweighed the added functionality. They lost over $40 million (Ragowsky and Somers, 2002).

Any time an organization experiences change, especially the kind associated with ERP, employees need time and training to overcome their resistance and adjust (Koch, 2002; Robey, Ross and Boudreau, 2002). The lack of proper training leads to resistance, which can destroy any ERP project. User training must include more than just giving employees the skills to operate the technology; they need to understand why the new system is needed and how the changes it creates will help of business be more successful (Manoeuvre, 2001). There are two different methods used to teach the technical aspect of the technology and business processes changes involved with implementing the new system (Robey, Ross and Boudreau, 2002). Some companies choose to concentrate on technology training first and defer considering the processes changes until later, while others take a more concerted approach and work to help employees understand the technology and process changes together (Robey, Ross and Boudreau, 2002).

The danger involved with training employees to implement and use ERP technology is losing them to the highly competitive job market for ERP-experienced workers (Manoeuvre, 2001). There is a global shortage of workers knowledgeable in ERP, so motivating and retaining them is that much more important (Jenson and Johnson, 1999; Kumar, Maheshwari and Kumar, 2002; Palaniswamy and Frank, 2000; Robey, Ross and Boudreau, 2002). Companies will always experience employee turnovers, but losing skilled ERP workers can be very detrimental to organizations. ERP training takes time because it involves teaching new technology, as well as a broader understanding of how their division links and affects other divisions and the company as a whole. In the past, employees only had to have the skills to accomplish their specific part of the

operation, but now each worker needs to have at least an elemental understanding of the entire process. The training is very intense, meaning it's easier to focus on retaining trained personnel instead of having to constantly educate incoming employees.

ERP represents a substantial investment in money, time, and internal resources (Hitt, Wu and Zhou, 2002). Correctly budgeting for purchasing, implementing, and maintaining an ERP project is challenging. ERP systems are expensive undertakings, and costs can escalating to over $100 million if a company chooses to implement multiple modules across numerous divisions (Robey, Ross and Boudreau, 2002). Companies need to look at more than just the cost of purchasing the software, because it is the hidden costs that can break the budget if not taken into account at the beginning of the project. To name a few, planners need to budget for consultants to assist in choosing and implementing the software, personnel training expenses, integration and testing costs if other corporate software is still going to be used, the money to convert the data from the old system to the ERP databases, and the slight depression companies experience while the organization adjusts to the new processes (Koch, 2002). Management often underestimates the costs associated with changes of this magnitude, which can cause projects to be scaled back midstream or abandoned entirely (Kumar, Maheshwari and Kumar, 2002; Legare, 2002; Robey, Ross and Boudreau, 2002). There is also a time element in ERP projects. Management likes to see immediate results, but that does not happen with ERP. The system can take months or even years to implement depending on the size of the company, the number of modules, the amount of customization needed, the extent of change necessary, and the way the system is introduced (Legare, 2002). It is

hard to schedule everything perfectly at the start, because it is a dynamic process. There is also a gap between going live with the system and when benefits start accruing that can be frustrating to workers and managers (Hitt, Wu, and Zhou, 2002). There can even be some moments of panic when productivity slips during the transition phase. ERP systems are expensive and time-consuming risks for any business, so proper planning and patience are necessities for success.

Integration is one of the benefits of ERP, but it can be detrimental to the entire organization if the data input is inaccurate (Robey, Ross and Boudreau, 2002). Data used to be contained in only one database within the company, but with integration, data entered in one place disperses to numerous units and databases in the system (Palaniswamy and Frank, 2000). If the error goes unnoticed, everything throughout the organization can be affected in a negative manner. Schedules for buying raw materials, manufacturing, and shipping could be flawed if the worker in customer service inputs a wrong quantity or delivery date. Training and data analysis are vital to stopping and catching the errors before they can infiltrate the system.

Finally, it can be difficult to measure the benefits of ERP systems (Ragowsky and Somers, 2002). Conventional methodology uses cost displacement as the only measure of success, but ERP systems need multi-dimensional evaluation criteria (Teltumbde, 2000). ERP can save organizations money, but they are also designed to do things like improve cycle times, increase on time deliveries, and make scheduling more effective and efficient. These can be measured with metrics, but there are also intangible benefits. Better communication flow, easier data access, and a broader understanding of how the

organization is interconnected cannot be calculated in numerical terms, but are important benefits of implementing ERP that should be acknowledged.

Air Force

The AF, like the other military services, is plagued by the problems associated with numerous, disparate legacy systems. The AF has the ability to pull together resources and information when necessary, like wartime, and it has taken steps to create a few systems that integrate portions of operations, but no one system currently exists that pulls everything together for day-to-day business. In times of war, Air Force Material Command (AFMC) sets up a logistics response cell to provide a one stop shop for information regarding spare parts, transportation, supply logistics plans, and depot maintenance activities (Van Hook, 2002). The various divisions and personnel involved work hard to quickly gather data and transmit the necessary information to the cell. This is not normal operating procedure. Normally, it takes much more effort and time to collect the information from the separate functional divisions' databases. Many organizations treat knowledge as power and are reluctant to share, or take the time out of their schedule to complete a task for someone not in their immediate chain of command. Legacy systems also operate using archaic code and are expensive to operate utilizing multiple internal subsystems and extensive interfaces ("The Study of…," 2003). Data is replicated across systems meaning errors are more likely ("The Study of…," 2003). The systems are not complaint with higher authority mandates and initiatives, and do not support a consolidated data view ("The Study of…," 2003).

In the last several years, the AF has taken steps to create a numerous integrated systems within sections. ATMS is a web-based solution created to track material transfers between AFMC and the three Air Logistics Centers (ALC) in real-time, and was later expanded to track delivery sites within each AFMC division (Restel, 2000). With over one million parts moving between the different agencies annually, a new system was needed to replace the labor-intensive, error-prone, and cumbersome manual data entry and paper-based tracking system that made gathering and extracting useful data nearly impossible (Restel, 2000). There was a need for a cost-effective, easy to use system that provided real-time data access in a detail-specific manner across various operating divisions that could provide reports in existing standard software programs like Microsoft Access, Microsoft Work, and Microsoft Excel (Restel, 2000). ATMS was successfully implemented in 1999 at Hill AFB, and at Tinker AFB and Warner Robins AFB in 2000. It meets most of the needs for tracking the different process steps involved in material delivery, from order requisition to customer receipt, and allows data access through desk-top level hardware or hand-held radio computers in the field (Restel, 2000). Items are tracked through each point using hand-held laser bar code scanners that recognize the 14-character alphanumeric bar code on the part and at the site (Restel, 2000). Converting several legacy data information systems has reduced errors while standardizing and computerizing the tracking process. Clients can access information via the Internet, and data is easily gathered to investigate shipping discrepancies (Restel, 2000). The systems cannot yet track depot maintenance items returning to the supply system, clear in transit records, track issues from other supply systems because there is no link between outside

supply systems. The tools to analyze data to ensure peak performance and help with continual improvement are also still being developed (Restel, 2000). This system has helped streamline the tracking process in one arena, but there is room for improvement and integration of systems beyond AFMC.

In 2001, the AF set up a Depot Maintenance Reengineering and Transformation team to review organic depot maintenance processes to look into areas for (Hoelscher, 2002; "The Study of…," 2003). In the IT arena, the team found a lack of fully supported integrated strategy, lack of user-oriented IT system to enhance depot productivity, and a failure of the systems to meet current user needs (Hoelscher, 2002). The depots use many separate legacy systems created before the development of desktop personal computer to track parts, plan for inventory needs, and schedule repairs with little to no integration between the systems (Restel, 2000). The systems were built to depot needs from years past with outdated and unique database language with minimal emphasis on user needs. The screens rarely run graphical displays, and gathering data for analysis across different systems takes time and effort due to archaic database design structure. As the AF has grown and changed, legacy systems have struggled to meet needs. With upgrades being nearly impossible to accomplish, new systems have been created to try to handle requirements, but links between the various systems are not there. The solution chosen to solve the problems consists of a COTS manufacturing resources planning/maintenance repair and overhaul (MRP II/MRO) product to improve depot maintenance processes ("The Study of…," 2003).

The Depot Maintenance Accounting and Production System (DMAPS), set up at AFMC depots, was the first integrated suite of systems projected to provide better production, material and financial information to the depot maintenance process (Eyermann, 2002; "The Study of…," 2003). It tracks labor and materiel costs better than legacy systems, to provide more accurate financial information for decisions and reporting by replacing all or parts of various legacy systems and necessitating the modification of interface data flows (Eyermann, 2002; "The Study of…," 2003). This technology advances streamlining the way ALCs do business (Eyermann, 2002).

AFMC has also set up an Enterprise Data Warehouse (EDW) to address what is repeatedly cited as the most important aspect of good supply management decisions, the availability of consistent and timely data ("The Study of…," 2003). The EDW brings together full spectrum of AF combat support data and information required by the warfighter by gathering and storing enterprise-wide data in a secure, reliable, and consistent manner ("The Study of…," 2003). The EDW will ultimately encompass data from all 23 Combat Support functions to enable modern decision-support tools to quickly provide clear and accurate decision-making information ("The Study of…," 2003).

The AF Portal is an AF initiative to help integrate information across the entire AF. The AF awarded the contract for the AF Portal to consolidate hundreds of legacy systems and supporting system interfaces at 110 bases into a single point of access (Onley, 2001; "The Study of…," 2003). It consolidates access to hundreds of existing systems into a single entry point, and enables access to logistics applications and functions through a standard web browser ("The Study of…," 2003). My.AF.mil is a

beta Web portal developed by Sytel Inc., based on industry standards, that merged more than 300 unclassified applications and allowed users to customize features based on job function (Onley, 2001).

Global Combat Support System (GCSS)-AF focuses on meeting the system integration requirements mandated by Congress and desired by military commanders ("The Study of…," 2003). It potentially incorporates 640 automated information systems into the GCSS architecture framework, delivering timely, accurate, and trusted information to the warfighter ("The Study of…," 2003). In August of 1995, the Standard Base Supply System (SBSS) was to be modernized under the GCSS-AF. The goal of the SBSS modernization and Integrated Logistics System-Supply (ILS-S) program was to provide a modernized supply system comprised of integrated COTS products from Western Pacific Digital Systems called Government Online Data (GOLD) ("The Study of…," 2003). It was abandoned as estimated ability to meet requirements without customization dropped from 60 percent to 30 percent as requirements were further refined, and costs rose and time overruns plagued the project ("The Study of…," 2003).

The Spares Campaign started in 2001 to modernize and reshape the entire spare-parts process to better support expeditionary operations and to put more spare in the hands of maintainers ("The Study of…," 2003). This is a revolutionary project for the AF because it attempts to span the supply chain, instead of focusing on very specific functions.

The AF has also recognized the need to explore integrated systems in various policies and plans. The September 2001 Installations and Logistics, Information Systems

Strategic Plan focuses on leveraging constrained resources, and finding more innovative ways to develop and modernize information systems to improve warfighter support ("The Study of…," 2003). It discusses the importance of integrating and sharing data across applications, ensuring web enablement on the AF Portal, and implementing IT ("The Study of…," 2003). The AF Supply Strategic Plan of January 2002 supports a supply system that is mission-oriented, agile, flexible, integrated, and customer focused. It stresses finding ways to move information and assets seamlessly between suppliers and customers in all operational environments ("The Study of…," 2003). The AF Chief of Staff also said that transformation is the key to the service's future, while General Jumper said the AF needs to stop concentrating on individual systems, and get air, space, and ground platforms to work together and share information (Elliot, 2002). Secretary of the AF Peters and General Ryan signed a memorandum in January 2001 outlining the need to investigate transformations in Oracle, Cisco, and IBM to exploit commercially available technologies to improve operations and reduce costs. General Lyles, AFMC Commander, put out an IT memorandum in July 2001. He expanded on the need to change IT operations to establish a robust AF information enterprise to improve AF effectiveness and efficiency by integrating core services through IT superiority.

Recently, to further improve material requirements predictions, AFMC surveyed nine different aerospace companies to find processes, practices, systems, and models they could emulate at the depot level ("Best Practices…," 2002). SAP and Oracle were mentioned numerous times as the single tool for budgeting and computing requirements in the course of visiting and interviewing the different companies ("Best Practices…,"

2002). Company C uses SAP to manage their depot maintenance repair material requirements from beginning to end, tying together the warehouse, distribution, receiving, transportation, item management, repair, spare parts acquisition, and delivery functions with under one integrated system ("Best Practices…," 2002). Company E rolled 13 separate computer systems into a single SAP system in 1998 to control their global systems from cradle-to-grave ("Best Practices…," 2002). Company F gained total asset visibility using SAP to track parts with serial number scanners at each point, and integrating the units and data with their ERP system (Best Practices…," 2002). An Oracle-based ERP system is used by Company H ("Best Practices…," 2002). The study recommends that AFMC formally investigate the possibility of using an advanced planning and scheduling system, like SAP or Oracle, to move away from the current historical based systems ("Best Practices…," 2002).

AF Standard Systems Group (SSG) announced a $45 million, enterprise-wide software license for Oracle database and Advanced Security Option products to license AF and unified commands hosted on AF bases (Vrosh, 2000). The goal is to save money, while enabling the AF to develop, deploy, and transition existing IT systems to latest technologies with breadth of Oracle products and support (Vrosh, 2000). The AF receives full enterprise coverage, plus attractive yearly support with no escalation through 2009, and utilizes the DoD's ESI initiative (Vrosh, 2000).

In the last five years, ERP technology has become increasingly common in commercial environment, but is still rare in military maintenance environments ("Maintenance Support…," 2002). The AF drafted a high-level ERP survey across AF

business processes looking into ERP business processes and technology issues (Mowbray, 2002). The survey was to explore all aspects of COTS ERP to provide guidance in determining if it fit AF needs, and provide advice on performance capabilities and implementation guidelines (Mowbray, 2002). The literature ends at that point, with no information about the results of the study.

To date, the Stock Control System (SCS) modernization project represents one of the most in depth research into an integrated software solution. SCS automates the management of supply and provides enhanced processing of stock control transactions and management information at inventory control points ("The Study of…," 2003). The modernization program was initiated to address operational shortcomings, enhance logistics capabilities and processes, and to achieve compliance with the technical mandates and initiatives ("The Study of…," 2003). The government commissioned BearingPoint and LOGTEC to help identify the best approach for continued modernization of the asset management process, functions, and systems defined by the SCS ("The Study of…," 2003). The study considered three alternatives: continued modernization of the SCS through componentization, using commercial best of breed (BOB) solutions, or an integrated package solution (IPS) ("The Study of…," 2003). The first alternative involves updating existing legacy system code, and moving the system to a web-based, modern architecture and infrastructure with data systems tailored to specific wholesale and depot level retail supply processes, procedures, and rules currently in use ("The Study of…," 2003). The second alternative, commercial BOB solutions, relies on using commercial packages selected for superior capabilities related to a specific subset

of SCS business functionality. It assumes that more than one commercial application will be needed to satisfy all business needs in order to optimize specific functionality ("The Study of…," 2003). The final alternative, IPS, is commonly referred to as an ERP solution. It is an application with a full suite integrating production, financial management, budgeting, distribution, and other business functions in a single package, using common data and practices across a business unit. It supports real-time information to for better decision-making, forces reengineering, and standardizes business practices across an organization ("The Study of…," 2003). The draft report findings reinforced the need to continue some form of SCS modernization, and recommended that the AF acquire and implement an IPS to support SCS processes and functions based on an analysis of cost, schedule, benefits, and risks ("The Study of…," 2003). IPS offers superior integration of data and processes, is best for meeting supply chain strategic goals and objectives, better leverages leading edge technology, is best for managing risk and achieving success, has lower, more predictable sustainment costs, enables the AF to focus on core competencies, and creates a foundation for future enterprise expansion ("The Study of…," 2003). Using and ERP solution also aligns AF supply management modernization with other DoD logistics modernization initiatives ("The Study of…," 2003).

There appears to be significant resistance to an ERP solution in the AF. The AF has had bad experience with COTS software in the past, like the GOLD failure in SBSS modernization ("The Study of…," 2003). There have also been some failures reported when several commercial businesses tried to implement ERP (Reynolds, 2001). A

background paper written by SSG advised the AF to steer clear of COTS ERP systems based on the intrinsic difficulties and unique requirements of the military logistics environment (Reynolds, 2001). The AF also lacks the top down direction and commitment necessary to reengineer business processes and modernize IT ("The Study of…," 2003). A champion, a committed leader, with leverage and seniority to drive and change process is required to bring organizational and stovepipe issues into line and overcome middle management resistance. The AF needs a dictatorial 'screaming zealot' to orchestrate supply modernization and position it to facilitate logistics modernization ("The Study of…," 2003).

Government

There has been an increased push for systems upgrade and integration within and between government agencies as operational and business requirements have changed in the 21st Century. With the end of the Cold War, the DoD recognizes the need for better battlefield management, the importance of bringing together intelligence from different sources, and the necessity of integrating business functions, materials, human resources, and supply chain information to improve warfighter support (Cross and others, 2002). Joint Vision 2020 identified 'Focused Logistics' as necessary to project and sustain forces in the future environment ("The Study of…," 2003). In 2000, the DoD's logistics strategic plan identified the modernization of logistics systems as a top DoD priority to cut costs, reduce infrastructure, shorten cycle times, and ultimately help soldiers in the field ("The Study of…," 2003). The 2001 Quadrennial Defense Review, the September 2001 terrorist attacks, and the ensuing global war on terrorism, documented and

highlighted the need to accelerate the DoD transformation efforts to meet emerging and changing threats ("The Study of…," 2003). These events and directions have resulted in numerous plans and efforts to integrate systems, to include testing the use of ERP technology by the DLA, US Navy, and US Army.

The Under Secretary of Defense (Logistics and Material Readiness) established the Joint Logistics Board (JLB) in September 2001 to assess policies and implications of implementing various initiatives ("The Study of…," 2003). The JLB is composed of senior logisticians from the various Services, the Joint Staff, US Transportation Command, and DLA ("The Study of…," 2003). The Future Logistics Enterprise (FLE) is one of the most important initiatives the JLB is responsible for assessing and shaping to meet policy and improve logistics throughout the DoD ("The Study of…," 2003).

The FLE provides the DoD's midterm vision (2005-2010) to accelerate logistics improvement, enhance support to the warfighter, and align logistics processes with the operational demands of the 21st century through an integrated set of six collaborative initiatives intended to ensure consistent, reliable warfighter support through enterprise integration and end-to-end customer service within DoD logistics operations ("Future Logistics Enterprise…," 2002). The initiatives in the FLE work to integrate logistics chains and commercial information systems to enhance warfighter sustainment, and meet the operational requirements of the National Defense Strategy ("The Study of…," 2003).

Depot Maintenance Partnerships is one initiative intended to decrease costs while enhancing depot support by enabling DoD organic depots to develop appropriate partnerships with the commercial sector, while recognizing a national security need for

DoD-retained depot maintenance capability ("Future Logistics Enterprise…," 2002). The Condition-Based Maintenance + (CBM+) initiative is based on inserting technology to better predict equipment failures to support improved maintenance capabilities and businesses processes to increase operational availability and readiness throughout the weapon system life cycle at a reduced cost ("Future Logistics Enterprise…," 2002). The third initiative, Total Life Cycle Systems Management (TLCSM), aims to improve weapon system sustainment by establishing clear responsibility and accountability for meeting specified warfighter performance requirements within program management offices, and hold program managers responsible for the overall management of a weapon system's life cycle ("Future Logistics Enterprise…," 2002). Assessing and aligning Executive Agents (EA) designations with warfighter requirements arising from the National Defense Strategy to improving warfighter support by ensuring that EA are responsive to the supported CINCs' deployment and sustainment requirements is the focus of the fifth initiative ("Future Logistics Enterprise…," 2002). The End-to-End Distribution initiative is directed toward streamlining warfighter support by providing materiel, including retrograde and associated information, from the source of supply or point of origin to the point of use or disposal on a worldwide basis to resolve process problems spanning functional and organizational boundaries with supply chains harmonized at the enterprise level ("Future Logistics Enterprise…," 2002). Finally, the Enterprise Integration (EI) initiative builds on ERP and other COTS modernization tools being used by the other Services and DLA ("Future Logistics Enterprise…," 2002). The goal is to encourage collaborative solutions and share knowledge to end the paper-based

interactions and batch-processed transactions among DoD customers that have led to thousands of logistics systems and associated interfaces that cost between $1.5 billion and $2.5 billion every year by utilizing new technology ("Future Logistics Enterprise…," 2002).

The last initiative is very important to the DoD. Joint Vision 2020 specifically mentions EI because the lack of it costs billion of dollars every year (Cross and others, 2002). One paper estimates that around 20 percent to 40 percent of labor costs in US are spent on gathering, storing, and reconciliation of data (Cross and others, 2002). This is no different within the DoD, and may be even higher due to the enormous amount of information stored in the thousands of DoD systems that usually do not easily share or consolidate data. EI tries to give highly skilled and trained personnel access to near real-time, actionable information provided by modern and commercially-based software products implemented to enable reengineered logistics processes and business rules ("Future Logistics Enterprise…," 2002). The Under Secretary of Defense is very interested in establishing EI, and sees ERP as an attractive solution (Cross and others, 2002)

Almost all these new initiatives rely on purchasing and implementing some form of software technology, but software is expensive ("Best Practices…," 1999). The Deputy Assistant Secretary of Defense tasked the Directorate for IT Acquisition and Investment to develop, lead, oversee, and maintain a Department-wide Enterprise Software Initiative (ESI) in June 1998 ("Best Practices…," 1999; Money, 2000). The DoD ESI and the Enterprise Software Agreements (ESA) are proving that managing the

acquisition of commercially available software at the DoD enterprise level reduces the cost of acquiring and maintaining software products by aggregating requirements and leveraging the DoD's buying power ("Best Practices…," 1999; Money, 2000). Various different software vendors have been awarded DoD-wide contracts to provide software to government agencies at lower costs than if bought on an individual basis. SAP Public Sector and Education, Inc. was awarded a blanket purchase agreement on 14 February 2002, to provide ERP software, maintenance, services, and training to DoD ("SAP Contract…," 2003).

Defense Logistics Agency: Business Systems Modernization (BSM)

DLA provides common logistics support to the Military Services using legacy materiel management systems such as the Standard Automated Materiel Management System (SAMMS) and the Defense Integrated Subsistence Management System (DISMS) ("The Study of…," 2003; "Summary of the…," 2003). These legacy systems are the products of decades of accumulated and divergent business practices, and are using technology that is obsolete and no longer supported by original equipment manufacturers and software support providers ("The Study of…," 2003 ; "Summary of the…," 2003). SAMMS and DISMS do not support target business practices of Joint Vision 2020, DoD logistics plans, or DLA strategic plans, they are costly to operate and maintain, and are not easily modified to support DLA's evolving business environment ("The Study of…," 2003).

In 1999, DLA initiated the Business Systems Modernization (BMS) program as part of the ongoing logistics transformation to evaluate and recommend the next

generation of mission critical applications and supporting infrastructure vital to support the warfighter ("The Study of…," 2003). BSM will replace SAMMS and DISMS at DLA Headquarters with integrated systems to link defense suppliers, government agencies, and military customers ("Lockheed Martin…," 2000). Andersen Consulting was given a five year, $389.8 million contract for the BSM program, and Lockheed Martin Systems Integration-Owego was chosen as a major subcontractor ("Lockheed Martin…," 2000). Their jobs are to help replace several DLA legacy systems with a COTS fully integrated, automated system capable of speeding items more quickly through the supply chain ("Lockheed Martin…," 2000). After an extensive study, requirements determination, vendor research and demonstrations, and a gap analysis, the BSM Team recommended that ERP from SAP and Advanced Planning System (APS) from Manugistics were the best fit for DLA ("The Study of…," 2003). The enterprise wide logistics management systems operates with common core application programs, keeps business rules separate from data, and contains data warehouses for storing business information ("The Study of…," 2003). Lockheed Martin is responsible for creating data interfaces, migrating more than 4 million items into the new system, system security, disaster recovery, and ensuring interoperability with other DoD legacy systems ("Lockheed Martin…," 2000). Using ERP, DLA has increased their capabilities to spot supply chain trends, better anticipate precise delivery dates, more accurately forecast future supply needs and share that information with other military branches, minimize risk of overpayment, backorders, and extended waiting periods for supplies ("Lockheed Martin…," 2000).

DLA received BSM Milestone 0 approval in December 1999 to enter Phase 0: Concept Exploration. In June 2000, the Joint Requirements Oversight Council (JROC) validated BSM's operational requirements document. BSM went on to receive Milestone I/II approval in August 2000 to enter the Concept Demonstration Phase that encompassed fiscal years 2001 and 2002 ("Summary of the…," 2003). DLA will moved into production and deployment phase late fiscal year 2002 ("Summary of the…," 2003).

Army: Wholesale Logistics Modernization Program (WLMP)

The US Army Material Command (AMC) operates six major subordinate commands that manage depots, arsenals, ammunition plants, laboratories, and procurement operations out of 285 locations worldwide ("US Army Material…," 2002). Army logistics systems were based on 1950s and 1960s technology, and depended on high inventory levels built to support a forward-deployed force against a Cold War enemy (Coburn, 2000). The wholesale logistics management system consisted of the Commodity Command Standard System (CCSS), the Standard Depot System (SDS), and associated software systems ("Background Leading…," 2003).

The CCSS supported inventory control, repair and buy decisions, and planning and budgeting at integrated material management centers (Coburn, 2000; "Wholesale Logistics Modernization…," 2003). The SDS supported property accountability and management, and depot maintenance at Army depots, arsenals, and AMC installations (Coburn, 2000; "Wholesale Logistics Modernization…," 2003).

In March 1998, the Under Secretary of Defense for Acquisition and Technology said "We can reinvent logistics along the lines of world class companies. Again, to

mandate commercial practices, we must extend our reliance on the private sector… In fact, the Army is leading the way in this area…" ("Army Wholesale Logistics…," 2000). The Secretary of Defense and the Defense Reform Initiative both agreed that the time was right to reengineer and modernize product support in the DoD by adopting best business practices, and streamlining to eliminate unneeded infrastructure ("Army Wholesale Logistics…," 2000). The Army's strategic planning guidance recognized that "The required transformation of the Army cannot occur without a corresponding Revolution in Military Logistics. We must revise our logistics concepts…" ("Army Wholesale Logistics…," 2000). In the fall of 1999, AMC's commanding general approved a corporate strategy to modernize and integrate management of AMC business processes and adopt an enterprise data environment to provide interoperability of IT to improve the efficiency and productivity of core activities ("US Army Material…," 2002).

The Army felt there was a definite need to modernize and integrate their wholesale logistics business processes and technology to sustain the 21st Century warfighter ("Background Leading…," 2003). Modernization is readiness issue to the Army. The current system was built around Cold War needs, but the environment has changed leading to the need to be more flexible and responsive to a broader range of missions, with fewer resources over a shorter planning horizon ("Army Wholesale Logistics…," 2000). The Army wanted an integrated system that can provide real-time information, remain flexible, and reengineer logistics processes to reduce response times, decrease inventory, and cut back the logistics footprint at a lower cost ("Army Wholesale Logistics…," 2000; Coburn, 2000).

The current system operates under 30 year old processes using 25 year old technology running on obsolete Cobol 74 with non-relational flat data files ("Background Leading…," 2003 ; "Wholesale Logistics Modernization…," 2003). Lack of centralized funding and support led AMC's supply support system to evolve into a complex, tightly integrated system that is difficult to maintain and relatively inflexible ("Background Leading…," 2003; "US Army Material…," 2002). The system is also costly to maintain, with extra costs added because of the 'government requested' formats and capabilities make the systems unique and fairly complicated ("Background Leading…," 2003; "US Army Material…," 2002).

There were many different automated data management systems in AMC, often site-specific solutions without access, sharing, or collaboration capabilities ("US Army Material…," 2002). The lack of system interfaces meant that government manufacturing and repair facilities did not have access to data repositories and data management systems, so a lot of time and resources were spent tracking down data from a variety of sources without a guarantee that all required information would be available ("US Army Material…," 2002). There were several efforts in 1998 and 1999 to standardize and centralize the modernization AMC's product data management systems, but all failed due to lack of AMC resources for centralized funding and concerns about abilities to meet site-specific needs ("US Army Material…," 2002).

Global Combat Support Systems-Army (GCSS-A) is the Army's new automated system that will replace and interface all existing automated combat support systems (CSS) through a series of functional modules like supply, property, maintenance, and

management, and will encompass personnel, financial, medical, and other non-logistics CSS functions ("Global Combat…," 2002). It will operate within Defense Information Infrastructure using COTS hardware and Windows NT operating systems ("Global Combat…," 2002).

AMC is sponsoring the Wholesale Logistics Modernization Program (WLMP), initiated to provide the required modernization and sustainment of wholesale logistics business processes ("US Army Material…," 2002). WLMP's vision is to provide agile, reliable, and responsive services by leveraging best practices and technology to enable AMC to deliver world-class logistics and readiness to the warfighter through an aggressive reengineering and application of business practices where applicable and appropriate, an overall logistics integration, and by incorporating COTS as the enabling technology ("Vision and Strategy…," 2003). WLMP is part of GCSS-A's second tier, modernizing AMC's CCSS and SDS, their largest wholesale logistics systems ("Army Wholesale Logistics…," 2000; Coburn, 2000). The WLMP framework provides six major services ("Wholesale Logistics Modernization…," 2003).

WLMP manages availability by balancing supply and demand by determining the network's ability to satisfy net requirements and modifying supply and demand until net requirements are zero ("Army Wholesale Logistics…," 2000). The software evaluates materiel availability and resource requirements necessary to support peace time, tactical, and strategic operations to ensure fleet readiness ("Wholesale Logistics Modernization…," 2003). The new system also manages supply for replenishments, acquisitions, maintenance needs, and redistribution actions by collecting supply

information from all suppliers, and managing the associated procurement and production schedules ("Army Wholesale Logistics…," 2000; "Wholesale Logistics Modernization…," 2003). Distribution is managed by controlling the storage and movement of physical inventory from where it is available to where it is needed by configuring the software to support warehousing, material management, handling, and transportation processes linked with DLA to satisfy demands and readiness requirements ("Army Wholesale Logistics…," 2000; "Wholesale Logistics Modernization…," 2003). WLMP's system manages demand by collecting demand information from customers and managing the associated delivery schedules, with the software programmed to capture actual customer demand, plan for buffer stocks, adjust for abnormal demand, and create demand patterns for new weapon systems ("Army Wholesale Logistics…," 2000; "Wholesale Logistics Modernization…," 2003). The system is capable of capturing and reporting the financial impact of all transactions, integrating internal and external financial data, and developing budgetary measurements in accordance with the Chief Financial Officers Act to perform financial control and reporting actions ("Army Wholesale Logistics…," 2000; "Wholesale Logistics Modernization…," 2003). Finally, WLMP maintains data in a centralized repository at the very core of the system to provide accurate and timely data to support AMC operations. The system is capable of supporting all activities requiring data from development, testing, fielding, sustainment and final disposition of material; effective storage, retrieval and presentation of data by eliminating redundancies while maintaining data accuracy; and supporting automated

functions and providing info to users at all levels ("Army Wholesale Logistics…," 2000; "Wholesale Logistics Modernization…," 2003).

For the Army, ERP represents a revolutionary change in business processes ("Wholesale Logistics Modernization…," 2003). They describe ERP as software designed to integrate the work processes that deliver products to satisfy customer orders and maximize efficiency, from production to customer sales ("ERP, SAP…," 2002). ERP is the backbone for integrating to optimize multiple applications enabling supply network operations, with a secondary role as an enabler of commercial best practices ("Army Wholesale Logistics…," 2000).

AMC tasked the US Army Communications-Electronics Command (CECOM) to modernize the Army's wholesale logistics management systems with best commercial practices in system selection and business process reengineering to implement WLMP ("Background Leading…," 2003; "US Army Material…," 2002). CECOM formed an alliance with Computer Science Corporation (CSC) for the modernization and sustainment of the Army's wholesale logistics business processes ("Background Leading…," 2003). Defense Information Systems Agency (DISA) will provide data processing for the transferred legacy systems, and the contractor will be responsible for providing the data processing services to enable the modernized services ("Background Leading…," 2003). The joint Army and CSC team worked to create an enterprise transformation plan to guide modernization activities over next several years ("Vision and Strategy…," 2003).

In fall 1999, the commanding general of AMC established the AMC ERP/Product Data Management (PDM) Integration Team (EPIT) to align engineering business processes and IT efforts and capabilities with AMC's corporate strategy and WLMP efforts ("US Army Material…," 2002). EPIT's task was to analyze AMC's logistical and product data management processes to determine the correct balance between ERP and PDM systems, analyze WLMP's selected product's (SAP R/3) ability to provide the support needed for product data management, and to provide a recommendation for an enterprise product data management solution ("AMC ERP/PDM…," 2001; "US Army Material…," 2002).

The EPIT consisted of three teams; Requirements, Alternatives, and Evaluation ("AMC ERP/PDM…," 2001). The Requirements sub-team captured data product requirements; what data products are needed?, where do you currently get the data?, what do you do with the data?, what are the current problems?, and improvement recommendations for the future ("AMC ERP/PDM…," 2001). The Alternative sub-team collected PDM cost data, resolve outstanding legal issues, and prepare draft alternatives section of the EPIT report ("AMC ERP/PDM…," 2001). The Evaluation sub-team developed evaluation criteria for the EPIT decision process, as well as a requirements list and alternative descriptions ("AMC ERP/PDM…," 2001).

The Army awarded their prime contractor and integrator, CSC, a contract worth $680 million on 29 December 1999 for a period of ten years ("Summary of the…," 2003; "Wholesale Logistics Modernization…," 2003). The lengthy and strategic alliance with CSC is based on maximum service level benefits for maximum performance bonus

awards ("Summary of the…," 2003). CSC's job is to manage and modernize the Army's two wholesale logistics management systems and reengineer business processes with best business practices and updated IT, and services can be expanded via task order (Coburn, 2000; "ERP, SAP…," 2002; "Summary of the…," 2003). The Army will transfer legacy system operation over to CSC on 1 July 2000 ("Summary of the…," 2003).

The combined Army and CSC team came up with seven alternatives to improve AMC's product data management capabilities to meet stated requirements, risks, and estimated life cycle costs, but chose ERP as the best alternative to meet their needs ("ERP, SAP…," 2002; "US Army Material…," 2002). They recognized that adopting new technologies for the sake of new technology rarely succeeds in bringing about desired business improvements, and realized that success hinges on the scope of beneficial changes it allows ("ERP Software Evaluated…," 2003). ERP packages that link sales forecasting, order entry, manufacturing, distribution, materiel management, inventory, and financial information functions are seen as the best solution for reengineering business processes to fit commercial best practices and realize cost savings ("ERP, SAP…," 2002; "ERP Software Evaluated…," 2003).

On 27 July 2000, the Team CSC ERP Package Evaluation and Selection working group issued a request for solution to vendors Oracle and SAP ("ERP Software Evaluated…," 2003). The team also talked with Lockheed-Martin and Rockwell Collins to learn their experiences from their ERP/PDM system implementations ("AMC ERP/PDM…," 2001). Both companies chose SAP R/3 as their ERP system, but chose a separate PDM product rather than use SAP's product lifecycle management module

("AMC ERP/PDM…," 2001). A package evaluation and selection effort took place to identify the appropriate ERP software to serve as the IT backbone for WLMP ("Vision and Strategy…," 2003). Four factors were used as the basis for evaluation: willingness and ability to partner with Team CSC; technical expertise in such areas as data migration and security; capability to satisfying the five functional areas required to be modernized; and the total cost of ownership of COTS software from initial migration through upgrades and maintenance ("ERP Software Evaluated…," 2003). Each vendor was required to provide a written solution and demonstrate the WLMP ERP software before the end of summer 2000 ("ERP Software Evaluated…," 2003). Demonstrations were held at a site of the vendor's choosing, and evaluation team members selected scenarios of likely business processes for vendors to demonstrate how their package would solve each scenario ("Army Wholesale Logistics…," 2000; "ERP Software Evaluated…," 2003).

By fall 2000, Team CSC recommended that WLMP use COTS SAP R/3 ERP package, but implement a standard PDM system that is government owned and operated ("ERP Software Evaluated…," 2003; "US Army Material Command…," 2002). AMC licensed all modules except payroll for WLMP ("US Army Material…," 2002). Accelerated SAP, which brings a proven step by step methodology based on the experience and expertise of thousands of implementations, and various tools like standard checklists, document templates, guidelines, and recommendations will be used during implementation ("Wholesale Logistics Modernization…," 2003).

The goal of the modernization effort is to reengineer current wholesale logistics business processes, facilitated by the appropriate enabling IT, to provide integrated, seamless, and flexible information management services in support of the Army's wholesale logistics mission ("Summary of the…," 2003). When fully implemented, WLMP will managing demand, supply, availability, distribution, data, and financial reporting and control ("Summary of the…," 2003). The desired outcomes include modernized and integrated business processes, enhanced decision support capabilities, a collaborative planning environment, improved advance planning, a single, actionable source of data, better forecasting accuracy, total asset visibility, and a real-time flexible system ("Vision and Strategy…," 2003). The warfighter gets reduced cycle times, lower out of stock rates, total visibility of orders from start to finish, worldwide visibility of assets in real time, powerful anticipatory logistics planning tools, and reduced stockage levels and logistics footprint ("Wholesale Logistics Modernization…," 2003). Business transactions will automatically update all related business areas once an order is input into the system, and all data will be kept in a centralized data warehouse for reporting needs ("ERP, SAP…," 2002; "US Army Material…," 2002). The centralized management during implementation of the same COTS product at each site means that logistical data and processes will be standardized across all sites ("US Army Material…," 2002). AMC will be able to better manage weapon system readiness with integrated demand planning, consolidated inventory records, and a standard BOM to identify all physical items required to make a weapons system ("Army Wholesale Logistics…," 2000). Mission-based requirements will be managed with the software's ability to

manage availability on a global level using worldwide historical usage data ("Army Wholesale Logistics…," 2000). AMC can also manage the global supply and distribution networks while integrating financial information across the networks ("Army Wholesale Logistics…," 2000). ERP will advance the 'seamlessness' of wholesale and retail logistics, and provide agile, responsive logistics infrastructure ("US Army Material…," 2002).

The Army does recognize a few challenges associated with implementing ERP. They want a separate PDM system because the PDM capabilities within most ERP systems are overly restrictive ("US Army Material…," 2002). There are also challenges in implementing a COTS package without any customization ("US Army Material…," 2002). Customization increases the price and complexity of the software, but changing all business processes to meet software architecture is difficult for government agencies that have to deal with unbending policies and specific regulations. The key to success of implementing an ERP program is the Command-wide commitment to optimize the benefits that can be derived from providing a modern solution for product data management business process requirements ("US Army Material…," 2002). The Army, like any organization, needs a champion at the highest levels to ensure that the initial resistance to ERP is overcome and the implementation continues successfully.

The Army awarded the WLMP contract in December 1999 ("Wholesale Logistics Modernization…," 2003). The enterprise transformation team was created to come up with the WLMP vision and strategy by the end of March 2000 ("Vision and Strategy…," 2003; "Wholesale Logistics Modernization…," 2003). The business process

reengineering and analysis report was done in September 2000 during the architecture phase ("Wholesale Logistics Modernization…," 2003). In the development and integration phase, the wholesale logistics modernization services description document and implementation plan was completed on 31 December 2001 ("Wholesale Logistics Modernization…," 2003). The development was completed in two phases; command neutral configuration completed June 2001, and command specific configuration completed December 2001 ("Wholesale Logistics Modernization…," 2003).

The new system is scheduled to be fielded in 3 releases between December 2001 and June 2004 (Coburn, 2000). Release 1 involves determining requirements, logistics product data management, accounting and finance ("Vision and Strategy…," 2003). Release 2 focuses on requisition processing, asset management, distribution management, inventory control, asset visibility, and accounting and finance ("Vision and Strategy…," 2003). Release 3 deals with material maintenance and repair, depot operations, and accounting and finance ("Vision and Strategy…," 2003). The system will be implemented at CECOM (Jan-Jun 02), TACOM (Jun-Nov 02), AMCOM (Oct 02-Jan 03), SBCCOM (Jan-Apr 03), and OBC (Apr-Jun 03) ("Wholesale Logistics Modernization…," 2003). Operations is the last phase involving sustainment services and continuous improvement running through 28 December 2009 ("Wholesale Logistics Modernization…," 2003).

Navy

In the mid-1990s, the Navy started the revolution in military affairs (RMA), which led the Secretary of the Navy John H. Dalton to ask Under Secretary of the Navy

Jerry M. Hultin to look into the Navy's strategic business plan in late 1997 ("ERP for Navy…," 2000; Kreisher, 2002). He initiated the revolution in business affairs (RBA) in 1998 to explore ways to improve and modernize the service's management capabilities, starting with financial practices and expanding to investigate commercial best business practices ("ERP for Navy…," 2000; Kreisher, 2002; Wilczynski, 2000). The Commercial Business Practices Working Group conducted a three week off-site to examine the current state and the direction of changes in commercial sector business practices, and come up with a plan for the Navy's future ("ERP for Navy…," 2000). They found many companies using integrated IT systems, usually in the form of an ERP system, to improve financial and customer service processes. ERP improves efficiency and effectiveness by modernizing and reengineering business process, and providing quality information to managers for better decision making ("ERP for Navy…," 2000).

In December 1998, the Navy's ERP program office stood up, and later awarded a contract to KPGM Consulting to serve as the Navy's consultant and integrator for ERP issues (Kreisher, 2002). Six pilot programs were recommended to test the ERP concept across various naval functions: NAVAIR for Program Management, NAVAIR/NAVSUP for Aviation Supply Chain Management, NAVSEA for Fleet Regional Maintenance, SPAWAR for the Navy Working Capital Fund Management, HQ USMC for USMC Logistics, and CINCPACFLT for Shore Station Management ("ERP for Navy…," 2000; Wilczynski, 2000). The first four pilots received approval and $100 million in funding, while the last two proposals are on hold until further notice (Murray, 2000). The pilots will test the effectiveness of ERP on a small scale, with plans to implement ERP Navy-

wide based on positive pilot results (Wilczynski, 2000). The Executive Steering Group, headed by Vice Admiral Lockhard, was established to monitor the pilot projects ("ERP for Navy…," 2000; Murray, 2000; Wilczynski, 2000). The four pilot program managers, DFAS, and DLA form the Integration and Coordination Board working to ensure enterprise-wide integration, and resolving any cross-pilot issues ("ERP for Navy…," 2000).

In 1997, the Secretary of Defense's Defense Reform Initiative stated that the "DoD has labored under support systems that are at least a generation out of step with modern, corporate America…DoD support systems and practices were developed in their own defense-unique culture and never corresponded with the best practices of the private sector (Louzek, 2000). The Navy has many disparate databases, suspect data integrity, no links between financial, maintenance, and supply data, and multiple data sources meaning it takes many months to get an answer and answers may be conflicting ("SMART/ERP Workforce…," 2002). They needed a tool to improve business processes, reduce inventory, and increase the quantity, quality, and integrity of their information to maximize the readiness of operating forces in the face of shrinking budgets and downsizing ("ERP for Navy…," 2000; Kann, 2002).

Gathering information to answer questions and make decisions is difficult with many disparate systems. When someone asked a question about the ownership cost of a weapon system, it took over a year to gather the data, as would questions about personnel or financial situations (Kreisher, 2002). The information was out of date when the question was finally answered (Kreisher, 2002). The Navy also wants to know exactly

what parts are installed on any individual aircraft. Without an integrated system it can take weeks to find out if, and where, a particular production series of parts are installed and how long they have been there. If a 'red stripe' alert is issued about a part that can fail after a certain time, the command must order an inspection of all units of that type of aircraft and may have to ground the entire fleet until that is completed (Kreisher, 2002). An ERP system can provide quality information to all levels of management to improve efficiency and effectiveness ("ERP for Navy…," 2000). The new system will provide a baseline configuration for every aircraft by tail number. All maintenance information on that aircraft will be loaded into the database that will automatically update the whole system (Kreisher, 2002). Instead of grounding all aircraft and inspecting them if a contractor reports a problem with a lot or part, the Navy will only have to ground with ones that have the defective part and keep the others flying (Kreisher, 2002). An ERP system is expected to reduce cycle times, provide employees with accurate, real-time data, fix information system redundancies, automate and integrate business processes, and give the Navy visibility throughout the various networks ("ERP for Navy…," 2000; Kreisher, 2002).

The Navy defines ERP as a set of business process solutions using an integrated relational database system to mange enterprise operations: sales, planning, purchasing, maintenance, inventory control, financials; share common data and practices across the enterprise; provide real-time information for decision making and performance management; and as a key enabler of business process reengineering using commercially available software solutions (Kreisher, 2002; "SMART/ERP Workforce…," 2002). ERP

provides the organization with the capability to manage their core business processes, and promises to provide access to superior information while promoting business process reengineering and standardization across the Navy ("ERP for Navy…," 2000; Louzek, 2000). The 'E' stands for enterprise which means that the core functions consist of IT applications that have an organization-wide affect (Louzek, 2000; Rowan, 1999). The 'R' for resources implies that the applications concern the management of financial as will as non-financial resources (Louzek, 2000; Rowan, 1999). The 'P' is for planning suggesting that the system focuses on the organizations improving their strategic decision-making as a whole (Louzek, 2000; Rowan, 1999).

The Navy chose ERP because it was used successfully by other large organizations to ensure the use of standard business processes and tools across the enterprise regardless of the program or site, all supported by a single common database (Kreisher, 2002). NAVAIR commander, Vice Admiral Joseph W. Dyer Jr., says that enterprise resource planning will provide a tool that "is going to give us the logistics equivalent of network-centric warfare… We will be more agile and we will be much more affordable (Kreisher, 2002). ERP's ability to integrate across Navy operations and sites will improve warfighter effectiveness in era of high demand and limited resources with ERP ("ERP for Navy…," 2000; Kreisher, 2002). It will enable the Navy to answer questions about where their 'stuff' is, what is it doing, what their return on asset investment is, and help them speed up cycle times (Kreisher, 2002).

All the pilot programs chose to use SAP (Systems, Application and Products in data processing) R/3 (real-time 3 client/server architecture) software ("SMART/ERP

Workforce…," 2002). SAP R/3 meets financial and other necessary regulatory standards, and is being used by commercial companies that perform many of the same type of business functions that the Navy does ("SMART/ERP Workforce…," 2002). American defense systems manufacturers, Lockheed Martin, Northrop Grumman, Raytheon, and Rockwell all use SAP R/3 ("SMART/ERP Workforce…," 2002). General Electric and Jet Aviation use SAP for their maintenance, repair, and overhaul services ("SMART/ERP Workforce…," 2002). Many international defense organizations, like the NATO Maintenance and Supply Agency, the Australian Defense Forces, the Danish Defense Forces, and German Defense Forces, also use SAP ("SMART/ERP Workforce…," 2002).

Navy undersecretary Jerry M. Hultin recognized the "no government agency of our size has ever succeeded at ERP, so we want to be damn sure we can do it right" (Murray, 2000). The Navy recognizes that implementing an ERP system is an expensive and long process. The Navy is spending $100 million just to test four pilots, leaving two of the pilots unfunded (Murray, 2000). Creating the specifications and bidding the development work out to the contractor for a military ERP or supply-chain is difficult because of the numerous security issues and rigorous military specifications meaning its much more complex than for a commercial installation (Songini, 2001). Moving the historical data to the new SAP system is costly due to the vast amounts of data that have to be moved and reconciled from numerous systems (Songini, 2001). The biggest problem the Navy has encountered is in reengineering to fit the new software. There are some areas that cannot be changed or require the use of legacy systems due to regulation and policy (Reynolds, 2001). The new ERP system and legacy systems, like

the Defense Financial Management System (DFMS), need to interface ("ERP for Navy…," 2000). The Navy has also realized that no single COTS package can handle all functionality required by the Department of the Navy, so the various packages need to interfaced as well ("ERP for Navy…," 2000). The Navy has been able to replace upwards to 265 legacy systems, but have run into several problems (Reynolds, 2001). The Navy is required to integrate with numerous Navy and DoD legacy systems, the Navy has been advised that they will have to interface with several other legacy systems that will not be waived, and fully implementing the ERP package is still pending the Navy's ability to prove that the new system can handle all the functionality of the legacy systems (Reynolds, 2001). The more legacy systems, the harder it is to reengineer processes to fit the ERP software meaning more customization and custom interfaces which cost money, time, and resources (Reynolds, 2001).

Naval Program Management Pilot: Project Sigma

The Naval Program Management Pilot, Project Sigma, is sponsored by NAVAIR ("ERP for Navy…," 2000; "Summary of the…," 2003). They are focusing on the acquisition of weapons systems, program management, financial management, and asset tracking-configuration management using the E-2C Hawkeye as their test bed (Kreisher, 2002; "Summary of the…," 2003). Their goal is to become a process-centered organization, focused on continuous improvement, while measuring performance and utilizing performance measurement to drive behavior and results ("ERP for Navy…," 2000; "Summary of the…," 2003).

In February 2000, KPMG Consulting LLC was awarded the one-year, $90 million NAVAIR ERP contract to provide and install field proven COTS SAP America Inc. ERP software with minimum customization (Caterinicchia, 2002; "ERP for Navy…," 2000; Murray, 2000; "Summary of the…," 2003). KPMG will team with SAIC and IBM to carry out the five year contract to assist with implementing ERP (Murray, 2000; "Summary of the…," 2003). NAVAIR expects its costs to be about $440 million through fiscal year 2007, but expect tremendous savings over time to pay for the implementation costs (Kreisher, 2002).

The implementation timeline revolves around a five year phased approach with a one year pilot followed by 12 to 15 month waves to achieve full ERP capability ("ERP for Navy…," 2000; "Summary of the…," 2003). NAVAIR began the deployment phase in March of 2001 ("Summary of the…," 2003). Phase 1, Pilot Demonstration, started in late 2002 at NAVAIR Headquarters' three executive program offices and a few small commands using data and processes from the E-2C Hawkeye program office (Caterinicchia, 2002; Kreisher, 2002; "Summary of the…," 2003). Phase 2 will started in January 2003, bringing the NAVAIR Warfare Centers online (Caterinicchia, 2002; Kreisher, 2002). The last phase concentrates on the aviation depot community, starting October 2002 and expected to be complete in early fiscal year 2004 (Caterinicchia, 2002; Kreisher, 2002).

Naval Working Capital Fund Management (NWCF) Pilot: Project Cabrillo

The Naval Working Capital Fund Management (NWCF) Pilot, Project Cabrillo, is sponsored by SPAWAR ("Summary of the…," 2003). PricewaterhouseCoopers was

selected in June 2000 as the integrator for this pilot ("ERP for Navy…," 2000; "Summary of the…," 2003). The ERP Program Office is managing this effort, with a project team assembled from across SSC San Diego ("Summary of the…," 2003). Project Cabrillo is focusing on improving business operations, processes, and support systems for financial management processes at SSC San Diego to manage the NWCF ("ERP for Navy…," 2000; Kreisher, 2002). They are integrating overall business practices and process to include strategic planning, project management, financial management, procurement management, asset management, and human resource management ("ERP for Navy…," 2000; "Summary of the…," 2003). Over 40 SSC San Diego legacy business systems will begin to be retired with associated cost savings ("Summary of the…," 2003).

The business case analysis completed in 1999, determined that addressing several functional areas of the enterprise would achieve the most operating cost reductions, and improvements in the efficiencies and effectiveness in their business operations ("Summary of the…," 2003). Initial ERP capability was rolled out July 2001 as the legacy systems were retired ("ERP for Navy…," 2000; "Summary of the…," 2003).

Navy Regional Maintenance Pilot: Project NEMAIS

The Navy's Enterprise Maintenance Automated Information Systems (NEMAIS) Pilot is sponsored by Naval Sea Systems Command (NAVSEA) and the staff of US Atlantic Fleet, and focuses on regional maintenance (Kreisher, 2002 ; "Summary of the…," 2003). IBM has been chosen as the integrator for this effort ("Summary of the…," 2003). The pilot deals with regional ship maintenance and workforce management, starting with Ships Intermediate Maintenance Activity Norfolk, with

possible expansion to Norfolk Naval Shipyard (Kreisher, 2002). The goal of this phased effort is to optimize intermediate and depot level maintenance support for the warfighter ("ERP for Navy…," 2000; "Summary of the…," 2003). The plan is to eventually install the ERP system in all Naval shipyard, Supervisor of Shipbuilding sites, Shore Intermediate Maintenance Activities, Trident Refit Facilities, all Naval ships and submarines ("Summary of the…," 2003) in the following order: Mid Atlantic Regional Maintenance, Norfolk Naval Shipyard, legacy data conversion, remaining seven maintenance regions, Supervisor of Shipbuilding sites, and finally mobile ERP for 300 Navy ships ("ERP for Navy…," 2000; "Summary of the…," 2003).

Naval Aviation Supply Chain Management/Maintenance Pilot: SMART

NAVSUP and NAVAIR are working together on Naval Aviation Supply Chain Management and Maintenance Pilot known as the Supply Maintenance Aviation Reengineering Team (SMART) project (Murray, 2000; "Summary of the…," 2003). The objective of supply chain management is to provide the highest levels of readiness and combat effectiveness to the warfighter by delivering the required support with limited resources ("ERP for Navy…," 2000; Songini, 2001; "Summary of the…," 2003). SMART is demonstrating that an ERP system can replace the Navy's legacy wholesale and stock point supply systems using the E-2C Hawkeye aircraft and LM-2500 Gas Turbine Engine programs ("The Study of…," 2003; "Summary of the…," 2003). The Naval Inventory Control Point's National Supply Management System (UICP), the Regional Stock Point systems (U2), and Naval Aviation Logistics Command Management Information Systems are the legacy systems scheduled to be replaced with

an ERP system (Kann, 2002). It is important for SMART to demonstrate the capability of a COTS ERP product to provide integrated wholesale and retail supply as well as intermediate and depot maintenance support for Navy shore-based units in a single software and process solution ("SMART ERP…," 2002; "SMART/ERP Workforce…," 2002). ERP is changing how NAVSUP and NAVAIR manage and schedule organic repair and local procurement processes ("SMART/ERP Workforce…," 2002).

The SMART pilot is a $50 million ERP supply-chain application to improve forecasting, repair scheduling, and inventory management processes by relying on supply-chain and maintenance modules from SAP AG's SAP.com web-based product suite (Songini, 2001). Electronic Data Systems Corporation won the contract and will serve as SMART's consultant and integrator (Murray, 2000). They will use software from SAP for ERP and APS from Manugistics (Murray, 2000; "Navy 'SMART ERP'…," 2003; "SMART/ERP Workforce…," 2002). Because SAP is Chief Financial Officer and Joint Financial Management Improvement Program compliant, they will get access to the Defense Financial Accounting Services (DFAS) to process accounts payable ("SMART/ERP Workforce…," 2002).

ERP represents a "significant milestone and the beginning of a revolutionary change in Department of Navy business practices," said Kevin Fitzpatrick, SMART ERP's Program Executive at NAVSUP. "It will allow our leadership to make better decisions based on real-time data and achieve a level of accountability we have never had before with our current legacy software" ("Navy 'SMART ERP'…," 2003). SMART replaces outdated supply, maintenance, and financial management systems with a

modern, responsive, accurate, and integrated system ("Navy 'SMART ERP'…," 2003). Many of the Navy's procurement systems date back to 1960s and have millions of lines of code. Maintaining the systems costs about $80 million a year (Songini, 2001). The Navy thinks it can slash $65 million from procurement software costs by switching from homegrown supply-chain system to SAP that are expected to cost about $16 million a year to maintain and upgrade (Songini, 2001). They also expect the ERP system to reduce inventory costs and lower inventory management-related infrastructure expenses by $100 million annually when SMART ERP fully integrated ("Navy 'SMART ERP'…," 2003).

The Navy is hoping to modernize and integrate their supply systems and applications with SMART. Common processes eliminate the need for reconciliation and replication. ERP will provide a seamless connection to suppliers to speed up replenishment times allow customers to procure parts for best price at a touch of a button. Parts management is expected to improve as plane maintenance and parts replacement are automatically tracked, giving total asset visibility throughout the entire supply chain. NAVSUP/NAVAIR are also relying on the new system to provide better, more flexible modeling capabilities (Kann, 2002; "Navy 'SMART ERP'…," 2003; "SMART/ERP Workforce…," 2002; Songini, 2001).

The SMART pilot initiative was launched in October 1999 and was scheduled for an October 2001 implementation focusing on the E-2C Hawkeye and the LM-2500 engine (Songini, 2001). The NAVSUP/NAVAIR Team developed the business case analysis based on ERP cost avoidance, planned the source selection, prepared a request

for proposal, and awarded the integrator contract to EDS, Inc. during Phase 0 ("ERP for Navy…," 2000; "The Study of…," 2003; "Summary of the…," 2003). They received approval to proceed to Phase 1: Reengineering that ran from late 1999 to July 2000 (Kann, 2002). The team mapped the 'as-is' supply and maintenance systems and identified areas for improvement for reengineering. A gap analysis was performed to help select the best software solution for SMART. They chose to use ERP from SAP, and APS from Manugistics. Finally, they made recommendations for the ERP pilot and developed the details for the next phase ("ERP for Navy…," 2000; Kann, 2002; "The Study of…," 2003; "Summary of the…," 2003). The actual pilot was rolled out for testing during Phase 2. The core functionality of the COTS ERP software will be tested at four locations by 440 users after designing the new processes, and configuring the software to match the reengineered business flows for 2,500 E-2C Hawkeye NIINs and 15 LM-2500 engine parts no longer managed in UICP ("ERP for Navy…," 2000; Kann, 2002; "SMART ERP…," 2002; "Summary of…," 2003). The SMART pilot go-live on 3 January 2003, was the final of four ERP pilots to do so ("Navy 'SMART ERP'…," 2003; "SMART ERP…," 2002). The first order was for four shear bolts from the Aviation Storekeepers from Helicopter Combat Support Squadron Eight (HC8), Norfolk. Within minutes of order initiation, the SMART ERP system located the parts, printed a picking ticket, and performed the proper financial and inventory transactions in real-time within the integrated system. The technicians received the bolts within 30 minutes ("Navy 'SMART ERP'…," 2003). Before Phase 3: ERP Rollout, they will develop additional functionality required to perform full supply chain management functions for all naval

aviation weapons systems and equipment based on the results of the pilot project (Kann, 2002). The first step is to replace national and regional supply management system, and put ERP in Fleet and Industrial Supply Centers and the Naval Inventory Control Point, with completion expected by the end of fiscal year 2004 (Kann, 2002). Then the team would implement ERP in aviation intermediate maintenance activities, and provide ERP to supply activities that support the intermediate maintenance departments, with expected completion by end of fiscal year 2007 (Kann, 2002). Finally, ERP will be rolled out to all other supply and aviation maintenance units beginning in 2007. Legacy systems will be retired as the different multiple COTS waves and reengineered processes are expanded to cover the entire system ("ERP for Navy…," 2000; "Summary of the…," 2003).

Interoperability

Enterprise software firms have used the promise of interoperability to sell their products, and the lack of it to chastise their competition for years (Morphy, 2002). There is little conclusive literature to answer the question of how well the various ERP providers can connect their programs to share data. Naysayers do not think that powerhouse vendors like SAP, Oracle, and PeopleSoft will ever allow data to flow easily from one application to another in a different system, due to egos and financial issues (Morphy, 2002). The next question relates to the success of interoperability between legacy systems and new ERP systems. Homegrown and enterprise applications are inherently incompatible, but they need to be integrated so they interact seamlessly because almost everything done within the business involves more than one of them ("Enterprise Application Integration," 2003). Most companies will have more than one

enterprise application, system, and database so the interoperability problem needs to be answered ("TIBCO Enterprise…," 2002). Government agencies, in particular, deal with large volumes of data with varying sensitivities, and use many disparate legacy technologies to manage that data. Lack of integration across separate systems makes it difficult for government agencies to efficiently distribute information internally and across organizational boundaries ("Government," 2003). Some believe that the introduction of Web services and Enterprise Application Integration software will remake the entire process of multiple vendor, and ERP to legacy program integrations (Morphy, 2002).

The majority opinion is that Web services and EAI will eventually make it possible for buyers to pick and choose among various vendors for customer service and ERP needs ("Enterprise Application Integration," 2003; Morphy, 2002). Using a Web service is a way for software programs to talk to each other and exchange data, without making mainframes and client servers obsolete (Morphy, 2002). Using a brokerage-type model, users deposit data in the Web, where it is transformed into a common format and stored until someone asks for the data (Morphy, 2002). Users can also access information from various providers through the Web (Morphy, 2002).

EAI provides a common framework for integrating incompatible and distributed systems, making it easier and faster to tie together applications so you can integrate them into business processes that span your organization ("Enterprise Application Integration," 2003). EAI automates end-to-end business processes by coordinating sequences of tasks and resources that perform them, and connecting each application to the integration

platform through a single point of contact called an adapter ("TIBCO Enterprise…," 2002). Adapters enable the application integration using simple configuration graphic user interfaces instead of hard-coding connections ("TIBCO Enterprise…," 2002). EAI providers offer packaged adapters for leading applications and information systems, and can help companies create adapters for legacy or custom applications when needed ("TIBCO Enterprise…," 2002). Any application that is connected to the integration platform is automatically connected to every other application and system, and the information is automatically transformed as is moves through the network to resolve incompatibilities ("TIBCO Enterprise…," 2002). EAI breaks down barriers between incompatible and distributed applications and databases to increase business agility and flexibility, and lays the foundation for connecting with partners to streamline business processes ("TIBCO Enterprise…," 2002). EAI solutions lets applications, databases, and mainframes communicate and interact automatically routing and transforming information to get where it needs to be, when it needs to be, in the proper format ("Enterprise Application Integration," 2003).

III. Methodology

Chapter Overview

This research uses a case study methodology to gather data concerning ERP uses in government and military organizations. This chapter discusses why the case study methodology was chosen, a definition of case study methodology, discusses the various types of cases studies, and goes through the stages of accomplishing a case study.

Method Comparison

Due to the wide range of research situations, researchers have devised several different strategies to collect and analyze empirical data. Choosing the right research method involves evaluating the types of research questions under investigation, the amount of control the researcher has over the behavioral events, and the degree of focus on current versus historical events (Yin, 1994).

Table 1. Method Comparison

Strategy	Form of research question	Control over behavioral events	Focus on current events
Experiment	how, why	yes	yes
Survey	who, what, where, how many, how much	no	yes
Content Analysis	who, what, where, how many, how much	no	yes/no
History	how, why	no	no
Case Study	*how, why*	*no*	*yes*

(Yin, 1994)

The case study is the best fit for this research into ERP technology applications. The questions asked in this research are mainly of the "how" and "why" type. "Why and how are other government and military organizations implementing and using ERP

technology?" "Where does the AF stand on the issue of ERP, and why?" ERP is also a contemporary issue that is bounded by the particular organization's planning for and implementation of the technology. This fits Yin's (1994) criteria for using a case study methodology. A study by Palaniswamy and Frank (2002) also found that case studies are the accepted method of studying new management information systems, like ERP, that are not merely part of the organization, but create organizational change in structures, and processes. Only the case study method can capture such dynamic and changing conditions (Yin, 1993). Yin (1994) also identifies four applications for the case study model that fit well with IT studies: to explain complex causal links in real-life interventions, to describe the real-life context in which the intervention has occurred, to describe the intervention itself, and to explore those situations in which the intervention is being evaluated has no clear set of outcomes.

Case Study Definition

This research is best served by the case study methodology. "A case study is an examination of a specific phenomenon such as a program, an event, a person, a process, an institution, or a social group. The bounded system, or case, might be selected because it is an instance of some concern, issue, or hypothesis" (Merriam, 1988). Case studies can quantitative or qualitative. Sometimes, case studies are the only viable alternative when a holistic, in depth investigation is necessary (Sjoberg and others, 1991; Tellis, 1997). Case studies are used when the nature of research questions are how? or why? and the amount of control is limited, to explore a question, program, population, issue, or

concern to answer research questions, completely describe a phenomenon in its own context, or explain linkages between causes and effects (Li, 2003).

Types of Case Studies

A case study can involve either single or multiple cases, and can involve numerous levels of analysis (Eisenhardt, 1989; Tellis, 1997). Yin (1993) identified specific types of case studies: exploratory, explanatory, and descriptive. Three other types were added by Stake (1995): intrinsic where the researcher has an interest in the case, instrumental where a case is used to understand more than what is obvious to the observer, and collective were a group of case studies is studied.

After the literature is used to explain what ERP is, this study will use a multiple-case exploratory case study methodology to explore ERP use in commercial and military environments. The DLA, the US Army, and the US Navy will be the three cases used to investigate and understand their uses of ERP.

Case Study Stages

Yin (1994) describes four stages of a case study to get from the initial research questions to a conclusion. The first step is to design the case study (Yin, 1994). There are five necessary components involved in designing a case study: the study's questions, the study's propositions, the unit of analysis, the logic linking the data to the propositions, and the criteria for interpreting the findings (Yin, 1994). Table 2 describes the five components and presents how they will be applied in this study.

Table 2. Five Design Components

Component	Description	Application
Questions	"How" and "Why" is the event occurring?	Interview questions, literature review
Propositions	Wherein do the answers lie?	Study of military organizations
Unit of Analysis	What is a "case?"	Government/military organization using ERP technology
Logic linking data to propositions	What use is all this data?	Government/military ERP uses and comparison to AF position
Criteria for interpreting findings		

(Yin, 1994)

Defining the initial research questions and selecting the cases to be studied will specify the organizations to be approached, the kind of data to be gathered, and the relevant population (Eisenhardt, 1989). There are two steps involved in setting up the case protocol: determining the required skills, and then reviewing and developing the protocol (Tellis, 1997; Yin, 1994). Setting up the case protocol is important to establishing validity and reliability, because it helps with replicability (Tellis, 1997). The protocol should include an overview of case study project, field procedures, case study questions, and a guide for case study report (Tellis, 1997; Yin, 1994).

Table 3. Case Study Protocol

Protocol	Explanation	Application
Overview of Project	-Background information -Issues under investigation -Literature that applies to subject	-Chapter 1: background section; explanation issues -Chapter 2: relevant literature
Field Procedures	-Procedures for gaining entry -General sources of information -Procedural reminders	-Contacts were found while researching literature -Contact made via telephone or e-mail -Interviews were accomplished via telephone or in person upon setting up a meeting time
Questions	-Reflect full range of research concerns	-Questions sectioned into general areas (What is ERP?, Why choose ERP?, How implement ERP?, Expected benefits?, Challenges?) -Open-ended questions used to solicit the greatest amount of information
Guide for Report	-Format for writing report	-Thesis format

(Yin, 1994)

The next step is to conduct the case study by collecting data (Tellis, 1997; Yin, 1994). Yin (1994) recognizes six primary sources of evidence for case study research: documentation, archival records, interviews, direct observation, participant observation, and physical artifacts.

Table 4. Sources of Evidence

Source of Evidence	**Definition/examples**	**Strengths**	**Weaknesses**
Documentation	*-letters, memoranda, agendas, study reports* *-review validity* *-corroborate evidence from other sources*	*-stable: repeated review* *-unobtrusive: exist prior to case study* *-exact: names, etc* *-broad coverage: extended time span*	*-retrievability: difficult* *-biased selectivity* *-reporting bias: reflects author bias* *-access: may be blocked*
Archival Records	-service records, maps, charts, survey data, diaries -determine origin and ensure accuracy	-same as above -precise and quantitative	-same as above -privacy might inhibit access
Interviews	*-open-ended: ask for opinions* *-focused: short interview with specific questions* *-structured: formal survey*	*-targeted: focuses on case study topic* *-insightful: provides perceived causal inferences*	*-bias due to poor questions* *-response bias* *-incomplete recollection* *-reflexivity: interviewee expresses what interviewer wants to hear*
Direct Observation	-investigator visits site to collect data	-reality: covers events in real time -contextual: covers event context	-time-consuming -selectivity: might miss facts -reflexivity: observer's presence might cause change -cost: observers need time
Participant Observation	-researcher participates in events being studied	-same as above -insightful into interpersonal behavior	-same as above -bias due to investigator's actions
Physical artifacts	-tools, art work, notebooks, computer output	-insightful into cultural features -insightful into technical operations	-selectivity -availability

(Yin, 1994)

Data can be qualitative or quantitative (Eisenhardt, 1989). It is typical to combine multiple data collection methods like archives, interviews, questionnaires, and observations to enhance reliability and validity (Eisenhardt, 1989).

The primary sources of data for this research involved reviewing documentation and conducting interviews. Documentation included ERP background information, to include generalizations made from commercial companies' ERP experiences. Reports and memoranda from government and military sources were used to gain insight into what the AF, the DLA, the Army, and the Navy were doing in relation to ERP. Interviews were conducted with various AF representatives and contractors to fill in the gaps concerning AF information. The people interviewed were often able to answer questions related to the ERP experiences of the other Services and DLA.

The third step is to analyze the case study evidence (Tellis, 1997; Yin, 1994). "Data analysis consists of examining, categorizing, tabulation, or otherwise recombining the evidence to address the initial propositions of a study" (Yin, 1994). Statistical robustness is not an absolute necessity in all case studies (Tellis, 1997). Instead, researchers rely on experience and literature to represent evidence in various ways, using various interpretations (Tellis, 1997). There are several analytical techniques: pattern-matching, explanation-building, time-series analysis (Tellis, 1997). Pattern-matching compares empirically based patterns with a predicted one. If patterns match the internal reliability is enhanced (Tellis, 1997). Cross-case patterns can also emerge from within-group similarities coupled with intergroup differences, and decrease danger of investigator reaching premature or false conclusions as a result of information-processing

bias (Eisenhardt, 1989). Explanation-building is a form of pattern-matching where an explanation of the case is built through an iterative process of refining and revising the proposition as the research process continues (Tellis, 1997). Time-series analysis is an experimental and quasi-experimental form of analysis (Tellis, 1997). Analysis should try to identify themes, and clarify points of ambiguity or confusion (Li, 2003).

This study will first consolidate all the information gained from commercial sources to understand what ERP is. Generalizations will be pulled from the literature review. The next step is to understand where the AF stands on the ERP issue, and why it feels that way. Facts and ideas were extracted from the literature and each interview. The ideas that showed up in the majority of the sources were considered to be common trends. The same common trend analysis was done to understand what the DLA and other Services are doing with ERP, and why based on the literature review and various interviews. These results will be explored further in Chapter 4.

Finally, the researcher develops the conclusions, recommendations, and implications based on the evidence (Tellis, 1997; Yin, 1994). This is the most important step from user's perspective, because a good research project will fail if not well explained to user (Tellis, 1997). Conclusions and recommendations resulting from the research and analysis will be presented in Chapter 5.

Validity and Reliability

Validity and reliability are two measures of research design. Validity is the appropriateness, meaningfulness, and usefulness of the specific inferences made from the measures (Tellis, 1997). Reliability is the degree to which observed scores are free from

measurement errors (Tellis, 1997). These measures have long been questioned in of case studies. Some common concerns include: less rigorous, lacks applicability to real life because too generalized, not replicable (Li, 2003; Tellis, 1997). In addition to using multiple cases, Yin (1994) discusses ways to maximize construct validity, internal validity, external validity, and reliability to improve the design of the case study. The table below explains the different tests and how they are implemented in this paper.

Table 5. Validity and Reliability

Tests	Case Study Tactic	Phase of Research to Apply Tactic	Recommendations Implemented in the Research
Construct validity Are the operational measures for the concepts being studied correct?	-Use multiple sources of evidence -Establish a chain of evidence -Have key informants review draft of case study report	-Data collection -Composition	-Data collected from literature and interviews -Results will be provided to key informants for review
Internal validity Is there a 'chain of events' between constructs?	-Do pattern-matching -Do explanation-building -Do time-series analysis	-Data analysis	-Research is exploratory based -Identifies patters across cases
External validity How applicable are the study's findings to situations outside those specifically under investigation?	-Use replication logic in multiple-case studies	-Research design	-Multiple-case study design used -Includes commercial companies, and various government organizations
Reliability Is the study replicable?	-Use case study protocol -Develop case study data base -Use multiple cases	-Research design -Data collection	-Structured data collection through use of case study protocol

(Yin, 1994)

IV. Analysis and Results

Chapter Overview

This chapter first answers the six investigative questions based on the analysis of the literature review and interviews. It then goes on to explain the research findings. Finally, it discusses the final recommendations to answer the research question.

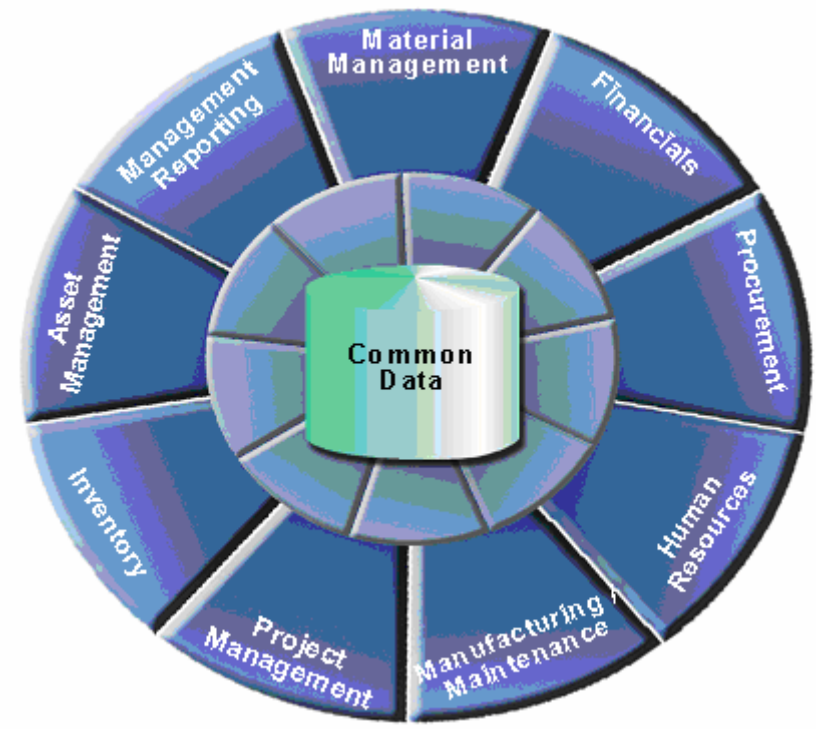
Investigative Question One

What is ERP?

The first part of the literature review in Chapter Two defines ERP, discusses the history of ERP, presents the leading ERP providers, covers average costs, goes through the most common reasons for choosing ERP, explains the stages and criteria involved in implementing an ERP system, and talks about the associated benefits and challenges of implementing and using and ERP system.

Definition.

ERP is an IT solution that is a process enabler and integrator that transforms business processes to utilize the best practices in the industry (Jenson and Johnson, 1999; Palaniswamy and Frank, 2000). ERP systems consist of complex software that attempts to integrate and automate the business processes of all departments and functions across a company onto a single computer system that can serve all those different departments' particular needs by tracking and recording every business transaction input from anywhere in the organization (Koch, 2002; Minahan, 1998; Palaniswamy and Frank, 2002).



("The Study of…," 2003)

Figure 2. ERP Diagram

History.

ERP evolved from MRP and MRP II systems through the improvement and advancement of computer technology. MRP translated the master schedule built for end items into time-phased net requirements for sub-assemblies, components, and raw materials planning and procurement ("ERP Overview," 2002). MRP II surfaced in the 1980s, extending MRP to shop floor and distribution management activities ("ERP Overview," 2002). MRP II is a sequential technique used for converting the master production schedule into operation planning and demand management, creating a detailed schedule for components to be made in-house or purchased from vendors (Kumar, Maheshwari and Kumar, 2002; Palaniswamy and Frank, 2000). ERP is the new

generation of IT for businesses that integrates data from all functional units in a relational, has graphical user interfaces, uses fourth-generation languages, has client-server architecture, and open systems capabilities database to improve manufacturing performance (Kumar, Maheshwari and Kumar, 2002; Palaniswamy and Frank, 2000).

Vendors.

The leaders ERP vendors are SAP, Oracle Corporation, PeopleSoft, Inc., JD Edwards and Company, and Baan International. Together, they account for 64 percent of total ERP market revenue ("ERP Overview," 2002; Jenson and Johnson, 1999). SAP is considered to be the originator of ERP and still dominates 30 percent of the market. They prefer to offer products and services to larger firms and are typically on the high end of the price scale (Palaniswamy and Frank, 2000). Oracle leads the Web-based market, and offers advantages like higher scalability and better coordination with suppliers and customers that globally dispersed companies appreciate (Palaniswamy and Frank, 2000). Global companies also choose Baan International, because they offer modules that do a good job of linking monetary and technology requirements of various countries that the organization operates in (Palaniswamy and Frank, 2000). There is also a growing market for smaller, less expensive, more specialized ERP suppliers among small to mid-sized companies outside of the manufacturing industry.

Costs.

There are varying numbers when it comes to the average cost of an ERP system because it depends on the company chosen, the number of modules installed, the size of the company, the amount of customization, installation time, and follow on services to

name a few of the variables, but $15 million came up most often as the average ERP cost (Hitt, Wu, and Zhou, 2002; Koch, 2002). Small companies with $10 million in annual sales typically spend around $200,000, mid-sized with $40 million to $70 million in annual sales can expect to spend $600,000 to $800,000, and larger companies will often spent several million dollars to implement ERP solutions (Ragowsky and Somers, 2002). There are also many hidden costs associated with ERP that companies need to be aware of when making the decision to go ahead with purchasing the software; training, integration and testing, customization, data conversion, data analysis, retaining employees, a fulltime ERP implementation team, waiting for promised returns on investment, and post-ERP depression are all typical costs not included in the original software estimate that need to be accounted for (Koch, 2002).

Reasons for ERP.

The reasons for choosing ERP are many and varied, but most managers understand that not implementing ERP would put them at a disadvantage within their industry (Teltumbde, 2000). Prior to 2000, the most common reasons for choosing ERP included Y2K compliance and the need to replace outdated legacy systems. To combat the shortfalls of legacy systems, ERP is installed to centralize and reduce redundancies by standardizing and integrating data throughout the company ("ERP Overview," 2002; Hitt, Wu, and Zhou, 2000). ERP is also often implemented as part of a process reengineering initiative. Finally, the push towards globalization and the challenges associated with multiple currencies and country-specific requirements make operations even more difficult to coordinate. ERP was designed to handle just this type of environment with its

ability to integrate and centralize distributed transactions across various databases (Jenson and Johnson, 1999; Teltumbde, 2000). In the ever changing and increasingly complex marketplace, ERP helps companies stay competitive.

Stages and Criteria.

Implementing and using ERP is a six-step process. The project is initiated to meet company needs. Then the company adopts an ERP consultant, vendor, and software package based on a set of 12 criteria:

1. Cost of ERP system
2. Best technology available
3. Benefits
4. Fit with strategy
5. Implementation time and ease
6. Amount of business process change required
7. Amount of customization
8. System functionality
9. Amount of risk
10. Ability to integrate processes and systems
11. Ease of use
12. Reliability

(Kumar, Maheshwari and Kumar, 2002; Teltumbde, 2000)

The software is then adapted to fit the particular organization's requirements. Finally, as system use becomes more common, acceptance, routinization, and infusion will fall into place.

Benefits.

Successfully installing ERP can provide many advantages to companies. The ability to integrate business functions to enhance cooperation and communication, enhancing decision making for employees and managers at every level, and introducing

best business practices into core business processes more effectively and efficiently than any other IT system to date is why many of the top companies are choosing to implement powerful ERP systems (Jenson and Johnson, 1999). ERP also standardizes business processes across functional areas, while decreasing the emphasis on functional silos (Hitt, Wu and Zhou, 2002; Kumar, Maheshwari and Kumar, 2002; Palaniswamy and Frank, 2000). Integration with ERP also improves the quality of the data flowing through the company (Kumar, Maheshwari and Kumar, 2002). The data is entered once, eliminating redundant data entry and the resulting errors, and automatically interacts with other modules for improved, real-time data accuracy (Kumar, Maheshwari and Kumar, 2002; "Scoopsoft…," 2002). The data is standardized so orders can be tracked, fulfilled, and the financial aspects managed easier than with legacy systems (Robey, Ross and Boudreau, 2002). More accurate data flows quickly through the company to enhance decision-making and performance. The real-time, accurate information available with an ERP system also leads to better worker and managerial decision-making (Hitt, Wu, and Zhou, 2002; Robey, Ross and Boudreau, 2002). Finally, ERP brings industry best practices into the organization due to the software architecture ("Scoopsoft…," 2002). Companies implementing ERP transform inefficient or outdated business processes supported with legacy systems to accepted best practices fully supported and even demanded by ERP (Hitt, Wu and Zhou, 2002). Company metrics should improve across the board after the adjustment period. Cost savings are generated from carrying less inventory and reduced systems maintenance translate into decreased cost of customer service (Hitt, Wu and Zhou, 2002).

***Challenges*.**

ERP requires intense planning, sweeping change, personnel adjustment, and large investments of money and time. Implementing ERP is not easy and can fail if not planned for or executed properly. Problems in the planning process are one of the most common pitfalls of ERP systems. Seventy percent of ERP implementations fail to achieve corporate goals or expectations (Kumar, Maheshwari and Kumar, 2002). Many times, ERP systems fail because the software cannot handle the sheer volume of transactions due to poor planning (Jenson and Johnson, 1999). Implementations also fail because companies opt to customize the software to support status quo operations instead of adapting to fit ERP's integrated architecture (Jenson and Johnson, 1999; Robey, Ross and Boudreau, 2002). The other problem is not managing the organization change effectively (Manoeuvre, 2001). The lack of proper training leads to resistance, which can destroy any ERP project. The other side of that issue is the danger involved with training employees to implement and use ERP technology can mean losing them to the highly competitive job market for ERP-experienced workers (Manoeuvre, 2001). Losing skilled ERP workers can be very detrimental to organizations, because ERP training is very intense, meaning it's easier to focus on retaining trained personnel instead of having to constantly educate incoming employees. Correctly budgeting for purchasing, implementing, and maintaining an ERP project can be challenging too. Finally, it is difficult to measure the benefits of ERP systems (Ragowsky and Somers, 2002). The benefits of better communication flow, easier data access, and a broader understanding of

how the organization is interconnected cannot be calculated in numerical terms, but are important benefits of implementing ERP that should be acknowledged.

Investigative Question Two

What is the AF's official position regarding ERP?

The AF's official position was discerned from interviewing AF personnel, because there is very little information presented in the literature that talks about the AF position on ERP. After consolidating the interview information, the common theme analysis was performed (Appendix 1). Analysis found that the AF position is 'wait and see,' or 'watch and learn' (Bedingfield, 2003; Dittmer, 2003; Hannaford, 2003). Everyone that was interviewed expressed the need to upgrade existing legacy systems (Bedingfield, 2003; Dittmer, 2003; Hannaford, 2003; Wright, 2003; Vicon, 2003). AFMC surveyed nine commercial aerospace companies in 2002 to find processes, practices, systems, and models that depots could emulate to improve material requirements predictions ("Best Practices…," 2002). SAP and Oracle ERP systems were mentioned by nearly half the companies surveyed, and the study recommended that AFMC formally investigate SAP and Oracle technologies ("Best Practices…," 2002). BearingPoint was commissioned to study the SCS Modernization project. The draft recommends that the AF use an IPS system to modernize the SCS, but SBSS and ILS-S have been added to the study to be addressed in the final report due August 2003. The Air Staff and ILS is awaiting the results of that study before they will make any decisions about ERP technology (Bedingfield, 2003; Wright, 2003).

The AF does have a couple of members that sit on the Program Implementation Group (PIG) that brings together representatives from the DLA, Army, and Navy ERP pilot programs to discuss progress, problems, and issues in a combined forum (Bedingfield, 2003; Hannaford, 2003). They are observing and learning from the experiences of the other ERP pilots. In the mean time, the AF is moving forward with other enterprise-type programs like the AF Portal, creating an EDW, and implementing DMAPS to integrate financial data at AF depots. These programs aim to modernize and integrate portions of business functions, but are not consistent with a complete ERP system.

Investigative Question Three

Why is the AF taking that position regarding ERP?

The answer to this question also comes largely from extracting the common themes from interviewing AF personnel (Appendix 1). The AF does not want to be forced to use ERP just because the other Services are testing the technology (Bedingfield, 2003; Wright, 2003). The AF wants to be able to take the time to explore ERP, as well as other alternatives.

Alternatives.

The BearingPoint study is looking at various alternatives to modernize the SCS to include componentization, best of breed software, using a government-owned software package from another government agency that performs that same functions as the US AF, and an IPS solution (Bedingfield, 2003; Dittmer, 2003; "The Study of…," 2003; Vicon, 2003; Wright, 2003). The AF is waiting on the recommendations of that study

before they make any solid plans to move forward with any modernization and integration technology.

COTS Concerns.

There is also some concern about using COTS technology. The AF did have a bad experience with a COTS package named GOLD (Government Online Data) that was originally intended to provide a modernized supply system (Bedingfield, 2003; Dittmer, 2003; "The Study of…", 2003). The AF had to abandon the program as costs soared and the fit gap became unbridgeable. The AF is using COTS technology, but still tends to tread carefully when deciding to use commercial technology.

Process Reengineering.

There has not been any research done to compare AF processes to the processes used in the ERP software. If the commercial processes were better, that would be a compelling reason to use ERP technology. Conversely, if the AF processes were better, that would be a compelling reason not to use ERP. Everyone interviewed expressed concerns about the amount of reengineering that ERP demands. There was some discussion of unique processes that the AF uses that ERP would not be able to replicate, or replicate as well, but no one was able to give a real solid example. The ERP system will be required to interface with other DoD systems and legacy systems mandated by policy or regulation, but the AF recognizes that the other Services have already dealt with those issues and have interfaces built that the AF can pirate for its own use if ERP is used (Bedingfield, 2003; Dittmer, 2003; Hannaford, 2003; Vicon, 2003).

No Infrastructure in Place.

Everyone that was interviewed, as well as the reviewed ERP literature, all agree that having strong, dedicated leadership at the highest levels is the most important critical success factor. Currently, the AF lacks that 'screaming zealot' that would make an ERP project possible (Bedingfield, 2003; Dittmer, 2003; Hannaford, 2003; "The Study of…," 2003; Wright, 2003). The AF is fragmented, with each location and section responsible for their own IT and processes. There are no incentives to work together to integrate their technologies and improve information flows. Each modernization project has its own schedule that it needs to meet, and taking the time to work with another organization could mean a project falls behind schedule. The three AF depots actually compete against each other, which completely eliminates the incentive to work together to optimize the entire network. There is also a general lack of funding to pursue ERP pilots (Bedingfield, 2003; Dittmer, 2003; Hannaford, 2003). The SCS received $18 million to modernize and another $18 million for sustainment last year, while SBSS received about $21 million total for modernization and sustainment last year (Bedingfield, 2003). ERP projects pursued by military organizations have run around $100 million. Even if different organization pooled their money, there is still no where near enough to consider ERP. There is some discussion about asking the OSD to help with funding, but nothing is really in the works to gain additional funding to test ERP right now (Bedingfield, 2003).

Investigative Question Four

What are other government and military organizations doing regarding ERP?

The information to answer this question came primarily from the literature review, with some supplemental information gained through interviews. A more comprehensive explanation of each case is presented in Chapter Two. The DLA, the US Army, and the US Navy are all testing ERP through a pilot study. Table 6 presents an overview of that the DLA and other Services are doing.

Table 6. Government and Military ERP Pilots

Service/ Agency	DLA	Army	NAVAIR	SPAWAR	NAVSEA	NAVSUP
Program	BSM	LMP	Sigma	Cabrillo	NEMAIS	SMART
Focus	Supply Chain Management	Wholesale Logistics	Program Management	Financial Management	Regional Maintenance	Aviation Supply Chain/Maintenance Management
Vendor	SAP	SAP	SAP	SAP	SAP	SAP
Go-Live Date	Jul-02	Dec-02	Oct-02	Jul-01	Jun-02	Dec-02

("The Study of…," 2003)

DLA.

In 1999, DLA initiated the Business Systems Modernization (BMS) program as part of the ongoing logistics transformation to evaluate and recommend the next generation of mission critical applications and supporting infrastructure vital to support the warfighter ("The Study of…," 2003). BSM will replace SAMMS and DISMS at DLA Headquarters with integrated systems to link defense suppliers, government agencies, and military customers ("Lockheed Martin…," 2000). Andersen Consulting was given a five year, $389.8 million contract for the BSM program ("Lockheed Martin…," 2000). After an extensive study, requirements determination, vendor research

and demonstrations, and a gap analysis, the BSM Team recommended that ERP from SAP was the best fit for DLA ("The Study of…," 2003). DLA received BSM Milestone 0 approval in December 1999 to enter Phase 0: Concept Exploration and expected to move into the production and deployment phase late fiscal year 2002 ("Summary of the…," 2003).

***US Army*.**

The US Army Material Command operates six major subordinate commands that manage depots, arsenals, ammunition plants, laboratories, and procurement operations out of 285 locations worldwide ("US Army Material…," 2002). In the fall of 1999, AMC's commanding general approved a corporate strategy to modernize and integrate management of AMC business processes and adopt an enterprise data environment to provide interoperability of IT to improve the efficiency and productivity of core activities ("US Army Material…," 2002). AMC is sponsoring the Wholesale Logistics Modernization Program (WLMP), initiated to provide the required modernization and sustainment of wholesale logistics business processes ("US Army Material…," 2002). The WLMP framework provides six major services:

1. Manages availability
2. Manages supply
3. Manages distribution
4. Manages demand
5. Captures and reports financial information
6. Maintains data in centralized data repository

("Army Wholesale Logistics…," 2000; "Wholesale Logistics Modernization…," 2003)

ERP is the backbone for integrating to optimize multiple applications enabling supply network operations, with a secondary role as an enabler of commercial best practices ("Army Wholesale Logistics…," 2000).

The ERP/Product Data Management (PDM) Integration Team (EPIT) was created to align engineering business processes and IT efforts and capabilities with AMC's corporate strategy and WLMP efforts ("US Army Material…," 2002). The Army awarded their prime contractor and integrator, CSC, a contract worth $680 million on 29 December 1999 for a period of ten years ("Summary of the…," 2003; "Wholesale Logistics Modernization…," 2003). ERP packages that link sales forecasting, order entry, manufacturing, distribution, materiel management, inventory, and financial information functions are seen as the best solution for reengineering business processes to fit commercial best practices and realize cost savings ("ERP, SAP…," 2002; "ERP Software Evaluated…," 2003). SAP and Oracle competed for the contract, and SAP ERP was chosen ("ERP Software Evaluated…," 2003). The new system is scheduled to be fielded in 3 releases between December 2001 and June 2004 (Coburn, 2000).

US Navy.

In December 1998, the Navy's ERP program office stood up, and later awarded a contract to KPGM Consulting to serve as the Navy's consultant and integrator for ERP issues (Kreisher, 2002). Four pilot programs were approved and received $100 million funding: NAVAIR for Program Management, NAVAIR/NAVSUP for Aviation Supply Chain Management, NAVSEA for Fleet Regional Maintenance, SPAWAR for the Navy Working Capital Fund Management ("ERP for Navy…," 2000; Murray, 2000;

Wilczynski, 2000). The pilots will test the effectiveness of ERP on a small scale, with plans to implement ERP Navy-wide based on positive pilot results (Wilczynski, 2000). The Executive Steering Group, headed by Vice Admiral Lockhard, was established to monitor the pilot projects ("ERP for Navy…," 2000; Murray, 2000; Wilczynski, 2000). The four pilot program managers, DFAS, and DLA form the Integration and Coordination Board working to ensure enterprise-wide integration, and resolving any cross-pilot issues ("ERP for Navy…," 2000). All the pilot programs chose to use SAP (Systems, Application and Products in data processing) R/3 (real-time 3 client/server architecture) software ("SMART/ERP Workforce…," 2002).

Sigma.

The Naval Program Management Pilot, Project Sigma, is sponsored by NAVAIR ("ERP for Navy…," 2000; "Summary of the…," 2003). They are focusing on the acquisition of weapons systems, program management, financial management, and asset tracking-configuration management using the E-2C Hawkeye as their test bed (Kreisher, 2002; "Summary of the…," 2003). Their goal is to become a process-centered organization, focused on continuous improvement, while measuring performance and utilizing performance measurement to drive behavior and results ("ERP for Navy…," 2000; "Summary of the…," 2003).

In February 2000, KPMG Consulting LLC was awarded the one-year, $90 million NAVAIR ERP contract to provide and install field proven COTS SAP America Inc. ERP software with minimum customization (Caterinicchia, 2002; "ERP for Navy…," 2000; Murray, 2000; "Summary of the…," 2003). KPMG will team with SAIC and IBM to

carry out the five year contract to assist with implementing ERP (Murray, 2000; "Summary of the…," 2003). NAVAIR expects its costs to be about $440 million through fiscal year 2007 (Kreisher, 2002).

The implementation timeline revolves around a five year phased approach with a one year pilot followed by 12 to 15 month waves to achieve full ERP capability ("ERP for Navy…," 2000; "Summary of the…," 2003). NAVAIR began the deployment phase in March of 2001 ("Summary of the…," 2003). The last phase concentrates on the aviation depot community, starting October 2002 and expected to be complete in early fiscal year 2004 (Caterinicchia, 2002; Kreisher, 2002).

Cabrillo.

The Naval Working Capital Fund Management (NWCF) Pilot, Project Cabrillo, is sponsored by SPAWAR ("Summary of the…," 2003). PricewaterhouseCoopers was selected in June 2000 as the integrator for this pilot ("ERP for Navy…," 2000; "Summary of the…," 2003). The ERP Program Office is managing this effort, with a project team assembled from across SSC San Diego ("Summary of the…," 2003). Project Cabrillo is focusing on improving business operations, processes, and support systems for financial management processes at SSC San Diego to manage the NWCF ("ERP for Navy…," 2000; Kreisher, 2002). They are integrating overall business practices and process to include strategic planning, project management, financial management, procurement management, asset management, and human resource management ("ERP for Navy…," 2000; "Summary of the…," 2003). Over 40 SSC San Diego legacy business systems will begin to be retired with associated cost savings ("Summary of the…," 2003). Initial ERP

capability was rolled out July 2001 as the legacy systems were retired ("ERP for Navy…," 2000; "Summary of the…," 2003).

NEMAIS.

The Navy's Enterprise Maintenance Automated Information Systems (NEMAIS) Pilot is sponsored by Naval Sea Systems Command (NAVSEA) and the staff of US Atlantic Fleet, and focuses on regional maintenance (Kreisher, 2002 ; "Summary of the…," 2003). IBM has been chosen as the integrator for this effort ("Summary of the…," 2003). The pilot deals with regional ship maintenance and workforce management, starting with Ships Intermediate Maintenance Activity Norfolk, with possible expansion to Norfolk Naval Shipyard (Kreisher, 2002). The goal of this phased effort is to optimize intermediate and depot level maintenance support for the warfighter ("ERP for Navy…," 2000; "Summary of the…," 2003). The plan is to eventually install the ERP system in all Naval shipyard, Supervisor of Shipbuilding sites, Shore Intermediate Maintenance Activities, Trident Refit Facilities, all Naval ships and submarines ("Summary of the…," 2003) in the following order: Mid Atlantic Regional Maintenance, Norfolk Naval Shipyard, legacy data conversion, remaining seven maintenance regions, Supervisor of Shipbuilding sites, and finally mobile ERP for 300 Navy ships ("ERP for Navy…," 2000; "Summary of the…," 2003).

SMART.

NAVSUP and NAVAIR are working together on the $50 million Naval Aviation Supply Chain Management and Maintenance Pilot known as the Supply Maintenance Aviation Reengineering Team (SMART) project (Murray, 2000; Songini, 2001;

"Summary of the…," 2003). The objective of supply chain management is to provide the highest levels of readiness and combat effectiveness to the warfighter by delivering the required support with limited resources ("ERP for Navy…," 2000; Songini, 2001; "Summary of the…," 2003). SMART is demonstrating that an ERP system can replace the Navy's legacy wholesale and stock point supply systems using the E-2C Hawkeye aircraft and LM-2500 Gas Turbine Engine programs ("The Study of…," 2003; "Summary of the…," 2003). ERP is changing how NAVSUP and NAVAIR manage and schedule organic repair and local procurement processes using supply-chain and maintenance modules from SAP AG's SAP.com web-based product suite ("SMART/ERP Workforce…," 2002; Songini, 2001). Electronic Data Systems Corporation won the contract and will serve as SMART's consultant and integrator (Murray, 2000). The SMART pilot initiative was launched in October 1999 and was scheduled for an October 2001 implementation focusing on the E-2C Hawkeye and the LM-2500 engine (Songini, 2001).

Common Trends.

Appendix 2 has the complete table of common trends amongst the various government and military ERP pilots. Trends were pulled from each case and those that showed up in a majority of organizations were pulled out and consolidated into broader topics.

To generalize, all three organizations felt a need to modernize and integrate their legacy systems to provide more effective and efficient warfighter support. Each created an official modernization plan supported by policy and strong leadership. The leadership

from the top is a key factor in each of the pilot studies. Then each organization hired a consultant to help with their modernization program. They also formed ERP teams consisting of personnel from inside the organization and the consulting firm. These teams than mapped out requirements for the new system and talked with commercial companies to find commercial best practices. All three organizations found ERP to be a commercial best practice. After researching the products from various vendors, and viewing live demonstrations, the teams picked the software they felt were the best fit for the price. All three organizations chose SAP for their software provider.

Each organization sited the importance of using COTS ERP with as little customization as possible. Within a government organization, there will always be some special requirements due to policies and regulations that require interfacing with some DoD and legacy systems. Each organization has built a toolkit of reports, interfaces, conversions, and expansions (RICE) that others can use if they have similar specialization needs. With attempting to use COTS, the organizations have stated their willingness to change their business processes to match those of the software. There were no mentions in the literature of specific unique processes that could not be accomplished using COTS ERP technology. Each organization has built an implementation plan, to include the use of phased releases. Phased releases give personnel the opportunity to adjust and be trained on the new processes and software over a longer time horizon which helps reduce resistance.

The major focus area is on wholesale or depot level supply processes. The DLA, the US Army, and the US Navy's SMART programs are all testing ERP on wholesale

and depot supply processes like managing inventory and to track supply metrics like availability, demand, backorders, and distribution. The Navy is also testing ERP on other functions, like regional maintenance, tracking and reporting financial information, and with program management.

It is important to note that all the current ERP pilots are operating at specific geographical locations where all the processes, personnel, and IT are owned in house (Bedingfield, 2003). This is definitely an easier proposition that trying to operate across different units and areas of responsibility. The Navy has plans to attempt to link their four pilot studies into a larger enterprise system. There is no guarantee of success, even though they all used the same ERP provider.

Investigative Question Five

Why are the DLA, the US Army, and the US Navy using ERP?

The information to answer this question came primarily from the literature review, with some supplemental information gained through interviews. A more comprehensive explanation of each case is presented in Chapter Two.

***DLA*.**

The DLA is using ERP to replace legacy systems that are the products of decades of accumulated and divergent business practices, and are using technology that is obsolete and no longer supported by original equipment manufacturers and software support providers ("The Study of…," 2003 ; "Summary of the…," 2003). SAMMS and DISMS do not support target business practices of Joint Vision 2020, DoD logistics plans, or DLA strategic plans, they are costly to operate and maintain, and are not easily

modified to support DLA's evolving business environment ("The Study of…," 2003). DLA wanted an integrated, automated system capable of speeding items more quickly through the supply chain ("Lockheed Martin…," 2000). The enterprise wide logistics management systems operates with common core application programs, keeps business rules separate from data, and contains data warehouses for storing business information ("The Study of…," 2003). By using ERP, DLA has increased their capabilities to spot supply chain trends, better anticipate precise delivery dates, more accurately forecast future supply needs and share that information with other military branches, minimize risk of overpayment, backorders, and extended waiting periods for supplies ("Lockheed Martin…," 2000).

Army.

In March 1998, the Under Secretary of Defense for Acquisition and Technology said, "We can reinvent logistics along the lines of world class companies. Again, to mandate commercial practices, we must extend our reliance on the private sector… In fact, the Army is leading the way in this area…" ("Army Wholesale Logistics…," 2000). The Secretary of Defense and the Defense Reform Initiative both agreed that the time was right to reengineer and modernize product support in the DoD by adopting best business practices, and streamlining to eliminate unneeded infrastructure ("Army Wholesale Logistics…," 2000). The Army's strategic planning guidance recognized that "The required transformation of the Army cannot occur without a corresponding Revolution in Military Logistics. We must revise our logistics concepts…" ("Army Wholesale Logistics…," 2000). In the fall of 1999, AMC's commanding general

approved a corporate strategy to modernize and integrate management of AMC business processes and adopt an enterprise data environment to provide interoperability of IT to improve the efficiency and productivity of core activities ("US Army Material…," 2002).

The Army wanted an integrated system that can provide real-time information, remain flexible, and reengineer logistics processes to reduce response times, decrease inventory, and cut back the logistics footprint at a lower cost to replace the current system operates under 30 year old processes using 25 year old technology running on obsolete Cobol 74 with non-relational flat data files ("Army Wholesale Logistics…," 2000; "Background Leading…," 2003; Coburn, 2000; "Wholesale Logistics Modernization…," 2003). Lack of system interfaces meant that government manufacturing and repair facilities did not have access to data repositories and data management systems, so a lot of time and resources were spent tracking down data from a variety of sources without a guarantee that all required information would be available ("US Army Material…," 2002). There were several efforts in 1998 and 1999 to standardize and centralize the modernization AMC's product data management systems, but all failed due to lack of AMC resources for centralized funding and concerns about abilities to meet site-specific needs ("US Army Material…," 2002).

WLMP's vision is to provide agile, reliable, and responsive services by leveraging best practices and technology to enable AMC to deliver world-class logistics and readiness to the warfighter through an aggressive reengineering and application of business practices where applicable and appropriate, an overall logistics integration, and by incorporating COTS as the enabling technology ("Vision and Strategy…," 2003).

WLMP is part of GCSS-A's second tier, modernizing AMC's CCSS and SDS, their largest wholesale logistics systems ("Army Wholesale Logistics…," 2000; Coburn, 2000). The WLMP framework provides six major services ("Wholesale Logistics Modernization…," 2003).

The goal of the modernization effort is to reengineer current wholesale logistics business processes, facilitated by the appropriate enabling IT, to provide integrated, seamless, and flexible information management services in support of the Army's wholesale logistics mission ("Summary of the…," 2003). When fully implemented, WLMP will managing demand, supply, availability, distribution, data, and financial reporting and control ("Summary of the…," 2003). The desired outcomes include modernized and integrated business processes, enhanced decision support capabilities, a collaborative planning environment, improved advance planning, a single, actionable source of data, better forecasting accuracy, total asset visibility, and a real-time flexible system ("Vision and Strategy…," 2003). The warfighter gets reduced cycle times, lower out of stock rates, total visibility of orders from start to finish, worldwide visibility of assets in real time, powerful anticipatory logistics planning tools, and reduced stockage levels and logistics footprint ("Wholesale Logistics Modernization…," 2003). Business transactions will automatically update all related business areas once an order is input into the system, and all data will be kept in a centralized data warehouse for reporting needs ("ERP, SAP…," 2002; "US Army Material…," 2002). The centralized management during implementation of the same COTS product at each site means that logistical data and processes will be standardized across all sites ("US Army Material…,"

2002). AMC will be able to better manage weapon system readiness with integrated demand planning, consolidated inventory records, and a standard BOM to identify all physical items required to make a weapons system ("Army Wholesale Logistics…," 2000). Mission-based requirements will be managed with the software's ability to manage availability on a global level using worldwide historical usage data ("Army Wholesale Logistics…," 2000). AMC can also manage the global supply and distribution networks while integrating financial information across the networks ("Army Wholesale Logistics…," 2000). ERP will advance the 'seamlessness' of wholesale and retail logistics, and provide agile, responsive logistics infrastructure ("US Army Material…," 2002).

Navy.

In the mid-1990s, the Navy started the revolution in military affairs (RMA), which led the Secretary of the Navy John H. Dalton to ask Under Secretary of the Navy Jerry M. Hultin to look into the Navy's strategic business plan in late 1997 ("ERP for Navy…," 2000; Kreisher, 2002). He initiated the revolution in business affairs (RBA) in 1998 to explore ways to improve and modernize the service's management capabilities, starting with financial practices and expanding to investigate commercial best business practices ("ERP for Navy…," 2000; Kreisher, 2002; Wilczynski, 2000). They found many companies using integrated IT systems, usually in the form of an ERP system, to improve financial and customer service processes. In 1997, the Secretary of Defense's Defense Reform Initiative stated that the "DoD has labored under support systems that are at least a generation out of step with modern, corporate America…DoD support

systems and practices were developed in their own defense-unique culture and never corresponded with the best practices of the private sector (Louzek, 2000).

The Navy is running four ERP pilots to test the effectiveness of ERP on a small scale, with plans to implement ERP Navy-wide based on positive pilot results (Wilczynski, 2000). The Navy has many disparate databases, suspect data integrity, no links between financial, maintenance, and supply data, and multiple data sources meaning it takes many months to get an answer and answers may be conflicting ("SMART/ERP Workforce…," 2002). They needed a tool to improve business processes, reduce inventory, and increase the quantity, quality, and integrity of their information to maximize the readiness of operating forces in the face of shrinking budgets and downsizing ("ERP for Navy…," 2000; Kann, 2002). Gathering information to answer questions and make decisions was also difficult with many disparate. An ERP system can provide quality information to all levels of management to improve efficiency and effectiveness ("ERP for Navy…," 2000). One vision is that the new system will provide a baseline configuration for every aircraft by tail number. All maintenance information on that aircraft will be loaded into the database that will automatically update the whole system (Kreisher, 2002). Instead of grounding all aircraft and inspecting them if a contractor reports a problem with a lot or part, the Navy will only have to ground with ones that have the defective part and keep the others flying (Kreisher, 2002). An ERP system is expected to reduce cycle times, provide employees with accurate, real-time data, fix information system redundancies, automate and integrate business processes,

and give the Navy visibility throughout the various networks ("ERP for Navy…," 2000; Kreisher, 2002).

The Navy chose ERP because it was used successfully by other large organizations to ensure the use of standard business processes and tools across the enterprise regardless of the program or site, all supported by a single common database (Kreisher, 2002). NAVAIR commander, Vice Admiral Joseph W. Dyer Jr., says that enterprise resource planning will provide a tool that "is going to give us the logistics equivalent of network-centric warfare… We will be more agile and we will be much more affordable (Kreisher, 2002). ERP's ability to integrate across Navy operations and sites will improve warfighter effectiveness in era of high demand and limited resources with ERP ("ERP for Navy…," 2000; Kreisher, 2002). It will enable the Navy to answer questions about where their 'stuff' is, what is it doing, what their return on asset investment is, and help them speed up cycle times (Kreisher, 2002).

Sigma.

NAVAIR's goal is to become a process-centered organization, focused on continuous improvement, while measuring performance and utilizing performance measurement to drive behavior and results ("ERP for Navy…," 2000; "Summary of the…," 2003). NAVAIR expects its costs to be about $440 million through fiscal year 2007, but expect tremendous savings over time to pay for the implementation costs (Kreisher, 2002).

Cabrillo.

Project Cabrillo is focusing on improving business operations, processes, and support systems for financial management processes at SSC San Diego to manage the NWCF ("ERP for Navy…," 2000; Kreisher, 2002). They are integrating overall business practices and process to include strategic planning, project management, financial management, procurement management, asset management, and human resource management ("ERP for Navy…," 2000; "Summary of the…," 2003). Over 40 SSC San Diego legacy business systems will begin to be retired with associated cost savings ("Summary of the…," 2003).

NEMAIS.

NEMAIS's goal is to optimize intermediate and depot level maintenance support for the warfighter ("ERP for Navy…," 2000; "Summary of the…," 2003).

SMART.

The SMART pilot aims to improve forecasting, repair scheduling, and inventory management processes by relying on supply-chain and maintenance modules from SAP (Songini, 2001). ERP represents a "significant milestone and the beginning of a revolutionary change in Department of Navy business practices," said Kevin Fitzpatrick, SMART ERP's Program Executive at NAVSUP. "It will allow our leadership to make better decisions based on real-time data and achieve a level of accountability we have never had before with our current legacy software" ("Navy 'SMART ERP'…," 2003). SMART replaces outdated supply, maintenance, and financial management systems with a modern, responsive, accurate, and integrated system ("Navy 'SMART ERP'…," 2003).

Many of the Navy's procurement systems date back to 1960s and have millions of lines of code. Maintaining the systems costs about $80 million a year (Songini, 2001). The Navy thinks it can slash $65 million from procurement software costs by switching from homegrown supply-chain system to SAP that are expected to cost about $16 million a year to maintain and upgrade (Songini, 2001). They also expect the ERP system to reduce inventory costs and lower inventory management-related infrastructure expenses by $100 million annually when SMART ERP fully integrated ("Navy 'SMART ERP'…," 2003).

The Navy is hoping to modernize and integrate their supply systems and applications with SMART. Common processes eliminate the need for reconciliation and replication. ERP will provide a seamless connection to suppliers to speed up replenishment times allow customers to procure parts for best price at a touch of a button. Parts management is expected to improve as plane maintenance and parts replacement are automatically tracked, giving total asset visibility throughout the entire supply chain. NAVSUP/NAVAIR are also relying on the new system to provide better, more flexible modeling capabilities (Kann, 2002; "Navy 'SMART ERP'…," 2003; "SMART/ERP Workforce…," 2002; Songini, 2001).

The first order was for four shear bolts from the Aviation Storekeepers from Helicopter Combat Support Squadron Eight (HC8), Norfolk. Within minutes of order initiation, the SMART ERP system located the parts, printed a picking ticket, and performed the proper financial and inventory transactions in real-time within the

integrated system. The technicians received the bolts within 30 minutes ("Navy 'SMART ERP'…," 2003).

Common Themes.

Appendix 2 has the complete table of common trends amongst the various government and military ERP pilots. Trends were pulled from each case and those that showed up in a majority of organizations were pulled out and consolidated into broader topics.

To generalize, the three organizations were all using obsolete, inflexible legacy systems that do not operate in the post-Cold War era. Most systems were operating on technology that was several decades old, built around unique military requirements. Upgrading, maintaining, and trying to interface those systems cost millions of dollars each year. The systems were not fully integrated, so obtaining information to answer simple questions was a monumental task. There was no guarantee of obtaining all the necessary data, and the accuracy and age were suspect from the information that was eventually received.

The organizations wanted modern, integrated technology to replace their aging legacy systems. They wanted a single, central database for all their data to be able to run analyses or answer questions. Real-time data visibility and automatic update throughout the entire system of inventory, maintenance, financials, etc. were important functions they expected their new system to be able to handle. Everyone wanted to be able to cut costs with new technology. Getting rid of the burden of maintaining and upgrading ancient systems represents a great cost savings in all the organizations. Finally, they

really emphasized the need to have the right information, at the right place, at the right time, in the right format to be able to make better, more informed decisions.

The DLA, the Army, and the Navy wanted to improve the efficiency and effectiveness to be able to better support the warfighter, and all see ERP as a best business practice and the best way to achieve their goals.

Investigative Question Six

Where is the logical place to test ERP, if the AF chooses to explore ERP technology?

The answer to this last question is the result of reviewing where the other Services and DLA are using ERP, and the interviews with AF personnel. It appears that testing a pilot at one AF depot, at all AF depots at the same time, or a combination of AF depots and retail supply would be the appropriate first step.

All the other services have pilot ERP studies that involve wholesale or depot level supply processes. The experience and toolkits they have built revolve around depot processes: supply, maintenance, scheduling, and financials. The AF could easily use them as a guide for setting up a similar pilot ERP test at an AF depot(s).

The majority of AF ERP knowledge also appears to reside mainly in the depot and supply communities. AFMC is aware of, and responsive/open to ERP. The BearingPoint study draft report already recommended that the SCS modernization use and IPS system. The results of the final draft should will probably recommend that the AF use and ERP system as a backbone, and add on some BOB modules and expansions ("The Study of…," 2003; Vicon, 2003). AFMC has also talked to industry and found that ERP technology should be explored for possible use in the depots ("Best

Practices…," 2002). Follow on pilot studies could involve retail supply and other logistics functions.

Research Findings

The following are a result of the insight gained from the literature review and interviews.

The AF is the only military service not using ERP technology.

The AF prides itself on being the most technologically advanced service, but is not testing the newest business management tool to upgrade 20 to 30 year old technologies in its logistics network. The DLA, the Army, and the Navy are all currently running ERP pilots. The AF is waiting to see how well ERP works for the other services, and is awaiting the results of a BearingPoint study on how to proceed with the SCS Modernization Program.

All current government and military ERP pilots are operating at stand alone locations.

Each pilot is testing one set of ERP processes at a location where the processes, personnel, and IT is owned by one entity. This makes the implementation process much easier than trying to use ERP across an entire enterprise. The Navy is making plans to link all their pilots together, but even though they are all using SAP there is no guarantee of success.

There is limited discussion of ERP training among the DoD ERP pilots.

The literature review of ERP talks a lot about the importance of training personnel in the right manner to keep resistance to a minimum for a successful implementation.

The three organizations studied in this research made little to no mention about if they feel training is important, and how they accomplished personnel training. Military organizations are notorious for resisting change, so it is interesting that resistance does not appear to be a concern for the ERP pilot programs.

The AF has no ERP leader.

The AF is concerned about modernizing their legacy systems, but it is all being accomplished in a fragmented manner without any incentive to work together. The literature and people that were interviewed stressed the importance of having a strong leadership to overcome the problems and resistance that sweeping changes like ERP systems involve. There was some discussion about a new office being created to ensure that wholesale and retail supply work together, but there is no guarantee that ERP will receive support from the top levels. Without top level support, ERP implementations are doomed to fail.

In the AF, there is a lack of knowledge about ERP outside the supply and supply chain functions.

The only people to be interviewed in relation to this research were all on the supply side of the AF. Successful ERP involves more than just supply functions; it involves maintenance, financials, human resources, manufacturing, repair, scheduling, etc. The other logistics functions need to be educated about ERP so would be able to support a possible AF ERP test pilot.

No one could answer the question about the level of interoperability between different software packages.

All the other organizations are using SAP ERP packages. If the AF were to choose to go with another vendor that fits AF needs better, no one knows how well the different systems could interface. The DoD vision is to some day have a DoD-wide enterprise where all the services could pass information seamlessly to optimize soldier support in times of war. The AF needs to answer the question about interoperability before they scope out different ERP vendors to ensure that it is able to be part of the DoD enterprise of the future.

Recommendations

It appears that the AF will have to make a decision concerning ERP in the near future. Once the results of the SCS Modernization study are in, the pressure from the OSD to use ERP can only be expected to increase. The AF is worried about being forced to use ERP technology just because everyone else is, but they fail to provide many viable alternatives that both modernize and integrate logistics systems. It is time for the AF to designate a leader that can guide the modernization and integration of legacy systems. AF depots are a logical choice for testing ERP. A team should be created to formally explore ERP technology. They can start mapping AF depot processes against ERP best practice business processes to see which are superior, and where the gaps exist. There still needs to be research into possible alternatives to ERP that would not require as much reengineering. The interoperability question also needs to be answered. The other pilots are still in the early stages of use, so they need to continue to be monitored to see how

successful they actually are over time. There are areas of concern, but that should not stop the AF from selecting a leader, putting a team together, and exploring how well ERP fits AF processes.

Summary

This chapter answers the six investigative questions to help understand what ERP is, where the AF stands and why, and how and why to DLA and other Services are using ERP. Several findings that arose in the research processes were discussed. Finally, the recommendation for the AF to start formally exploring ERP is based on the results of the questions and research findings.

V. Conclusions and Recommendations

Chapter Overview

This last chapter briefly discusses some of the limitations of this thesis, and presents suggestions for follow on research.

Limitations

The scope of this study was limited to US government and military ERP implementations because it was assumed that the US Air Force has many of the same requirements and processes that the other US Services have. The number of relevant cases was also limited to three; DLA, Army, and Navy's four pilots. The current pilots are also focusing mostly on the wholesale and depot supply functions. All the pilots are also in the very early stages of use, so the ultimate success or failure of them is still quite questionable.

Recommendations for Future Research

1. Research and monitor the process the Navy uses to link and integrate their four ERP pilot tests.

2. Map AF depot processes against ERP business processes to see which are better, and where the gaps exist.

3. Evaluate aspects of interoperability between different ERP software packages.

4. Apply Diffusion of Innovation methodology to understand institutional barriers to ERP implementation.

Research Summary

This research succeeded in bringing large volumes of literature together to understand ERP's uses in the commercial and DoD sectors. Exploring the DoD organizations that are using ERP helped build a case for recommending that the AF move from 'watching and learning' about ERP, to formally exploring the possibility of using ERP technology. The AF does have a need to modernize and integrate its legacy logistics systems, and ERP appears to be a viable solution that needs further study. The AF cannot afford to be the weak link in the enterprise.

Appendix 1. Interview Common Trends

#	Common theme	AFMC	Air Staff	MSG (SCS Modernization)	SSG (ILS)	Contractor (SCS Modernization)
1	Knowledgeable about DLA and other Services' ERP pilots	X	X	X	X	X
2	AF can use experiences/data from DLA and other Services if AF chooses to use ERP	X	X		X	X
3	Understands the AF's position on ERP to be 'wait and see' or 'watch and learn'	X	X		X	
4	Waiting on results of BearingPoint study before making decision about ERP		X	X		
5	There is a need to upgrade existing legacy systems	X	X	X	X	X
6	Discussed a bad AF COTS experience		X		X	X
7	Knows the AF is using COTS software in other areas	X	X		X	X
8	Does not want to use ERP just because everyone else is; wants to explore and understand ERP better		X		X	
9	There are ways to achieve integration without use ERP		X	X	X	X
10	Discussed other alternatives to ERP		X	X	X	X
11	Does not think the AF can use COTS ERP without some level of customization	X	X	X	X	
12	Concerned about need to reengineer business processes; want to study reengineered processes	X	X	X	X	X
13	Leadership at the top levels is the most important success factor for ERP implementation	X	X	X	X	X
14	AF lacks a top level leader to push possible ERP project	X	X	X	X	X
15	Lack of ERP funding as an issue	X	X		X	
16	There is no incentive or framework for organizations to work together when buying/implementing a new system	X			X	
17	Depot, Depots, and or Retail supply function would be the first place to test ERP pilot	X	X		X	X
18	Does not know how interoperable ERP software from different vendors is	X	X	X	X	*x (Said it wouldn't be a problem)*

19	Represented on the Program Implementation Group (PIG)	X	X			
20	AF has unique processes the will not work in an ERP system		X		X	
21	Could give a solid example of a unique AF process that could not be done with an ERP system					

Appendix 2. DLA, Army, and Navy Common Trends

#	Common Trend	DLA	Army	Navy	Sigma	SMART	Cabrillo	NEMAIS
1	Sends a representative to the PIG	X	X	X	X	X	X	X
2	Willing to share ERP experiences with others	X	X	X	X	X	X	X
3	Have built *RICE to share with the other Services	X	X	X	X	X	X	X
4	Trying to minimize COTS ERP customization	X	X	X	X	X	X	X
5	Gov't policies/regulation have forced level of customization to interface with DoD and legacy systems	X	X	X	X	X	X	X
6	Are reengineering business processes to fit ERP software	X	X	X	X	X	X	X
7	Have support of top leadership	X	X	X	X	X	X	X
8	Were using obsolete, costly, inflexible legacy systems that do not operate well in the post-Cold War environment	X	X	X	X	X	X	X
9	Had problems answering questions b/c hard to get accurate, timely data		X	X		X		
10	Set up modernization program	BSM	WLMP	4 Pilots				
11	Wanted to replace legacy systems with an integrated system	X	X	X	X	X	X	X
12	Hired a consultant to help w/modernization and integration	X	X	X	X	X	X	X
13	Determined requirements for new system	X	X	X	X	X	X	X
14	Talked with commercial companies to learn their ERP experiences		X	X				
15	See ERP as a commercial best practice	X	X	X	X	X	X	X
16	Set up an ERP team	X	X	X	X	X	X	X
17	Conducted vendor research/demos prior to choosing vendor	X	X	X	X	X		
18	Cost of ERP package was important	X	X	X	X	X	X	X
19	Chose SAP ERP	X	X	X	X	X	X	X
20	Like ERP's common core applications	X	X	X	X	X	X	X
21	Have a data warehouse	X	X	X	X	X	X	X
22	Needed real-time information	X	X	X		X		
23	Needed availability data	X	X	X		X		
24	Needed supply data	X	X	X		X		

25	Needed demand data	X	X	X		X		
26	Needed distribution data	X	X	X		X		
27	Needed financial data	X	X	X	X	X	X	
28	Needed to cut costs with new IT systems	X	X	X	X	X	X	X
29	Needed ERP to help make better decisions	X	X	X	X	X	X	X
30	Each pilot is at specific geographical location where all processes/personnel/IT owned in-house	X	X	X	X	X	X	X
31	Plan a phased release	X	X	X	X	X	X	X
32	ERP used in wholesale/depot level supply arena	X	X	X		X		
33	Use ERP for inventory functions	X	X	X		X		
34	Use ERP for maintenance functions		X	X		X		X
35	Use ERP to do financial functions			X	X	X	X	
36	Use ERP for scheduling functions		X	X		X		
37	Using COTS besides ERP	X	X	X		X		

Appendix 3. AFMC Interview

What information do you have about what the DLA and other Services are doing with ERP?

The Navy is working on convergence; integrating and expanding ERP systems from 4 pilot studies.

The Army is using ERP under their WLMP program to integrate their legacy systems.

The DLA is using ERP in their BSM program. They have changed many regulations and thought processes.

What is the AF doing with regard to ERP?

The AF is not doing much with ERP, it has a wait and see attitude. The AF is still in the mindset to map the current processes and then create software to fit those processes; in other words buying new technology to support the way we've always done things.

Why does the AF need to modernize its legacy systems?

AFMC Supply/Maintenance has 5 pages of legacy systems with about 15 systems per page, for a total of about 75 systems.

A lot of time and money is spent figuring out how to pass data between those legacy systems. Figuring out the timing between the systems is difficult because one system may need to upload its information before another system, etc.

It also costs a lot of money to purchase/create interfaces between the systems. For example, the Navy has one interface with their SAP systems where the AF has 100 interfaces for the same thing.

The AF also spends a lot of time generating software change requirements.

One big problem with the legacy network is that people forget where the data comes from. The actual system that creates the data may not be where most people go to obtain the data.

Right now, each unit decides what software to use independent of other units/commands. There are many different systems all over the place, some even doing the same things.

The depots are using MRP II systems for maintenance, but the MRP II systems do not usually support maintenance, repair and overhaul (MRO) processes. MRP II goes one way with putting things together, but does not do well with tearing apart and repairing. MRP II cannot handle the uncertainty of the possibility of having broken parts when something is being torn down and fixed. To date, the AF has spent $314 million under an 8-year contract to fix the software problem, but still cannot figure out how to include the uncertainty factor to make forecasting easier. Western Data Systems (bought out by Manugistics) created a system that the AF is testing with a pilot on 31 March 2003.

On the supply side, the AF spends $35 million each year to enhance and maintain their stock control systems.

Why is the AF not exploring/using ERP?

One downside to ERP is that it takes a long time to plan for and implement, while the AF needs a new system right now. The AF also has no money in the PALM for ERP. There are many steps to a successful ERP implementation, but support from the top if vital. The AF does not have a leader for ERP.

What have the other Services done that the AF can learn from?

There are many similar processes within the Navy and the AF. The AF should be able to take Navy experiences and software and copy them. The Navy has also created standard document interface templates, business processes, and code with DFAS/DFIS for SAP, Oracle, and Manugistics. The AF can save a lot of time and money if they can utilize what the Navy has learned.

Appendix 4. Air Staff Interview

What information do you have about what the DLA and other Services are doing with ERP?

Sits on Program Implementation Group (PIG) where all DoD ERP implementation pilot's representatives meet to discuss and work through ERP implementation issues. Each ERP pilot test is at geographical location where the processes, personnel, and IT are owned in house. Each pilot test is trying to customize as little as possible. If they do have to customize something, they share the Reports, Interfaces, Conversions, and Extensions (RICE) that they built with other services that need the same thing. They openly share experiences and products.

The Army is expanding their ERP program to include retail supply beyond the original wholesale supply focus. They actually turned over everything to their contractor (CSC), who is responsible for taking on technology and personnel to make conversion.

The DLA is still in the first section of rollout and use, meaning they have only 5 percent of functionality at this time.

What is the AF doing with regard to ERP?

The AF is in a 'watching and learning' position when it comes to ERP. Air Staff and AFMC LG will make ultimate decision about ERP for logistics. The Supply arena is the most up to speed on what ERP is and how it is being used in the DoD; maintenance and transportation arenas are behind supply when it comes to ERP uses. The AF is waiting on the results of the SCS Modernization study being done by BearingPoint before they move forward with any solution. The study is currently in draft form. The AF wants the study to make clearer arguments by better explaining the alternatives, exploring more alternatives, and having better justification for their results/recommendations.

Why is the AF not exploring/using ERP?

The key question is whether commercial processes (best practices in ERP) are better than the AF's or are the AF's better than the commercial processes has not been answered. The answer will be a compelling reason to change business processes with new software or continue to work the way we always have.

It is difficult to get everyone to agree. There are three areas of within AFMC LG, three separate ALCs, then add IL to the mix.

No funding exists for ERP. Supply systems are funded in 20-30 different systems controlled by three camps. SCS received $18 million for modernization, and $18 million for sustainment. SBSS got about $21 million to do both last year. An ERP system, that typically costs over $100 million for DoD organizations, cannot be funded by any one area or even by combining different areas.

The AF lacks a zealot or czar capable and willing to drive the change and overcome the difficulties.

If the AF were to explore/use ERP technology, where would be the best place to test ERP?

It is easier to test and use ERP everything is owned at one location. Starting at one ALC and moving to all depots, and then maybe incorporating retail supply would be reasonable. The leader would have to be three or four star General or SES equivalent to be able push the changes from the very top.

How interoperable are the different ERP software systems?

Did not know for sure if the various packages are interoperable. There is a question about the level of interaction the systems will really need. The OSD's long-term vision is to link the DoD in one enterprise, but how much do the services really need to pass information between each other?

Appendix 5. MSG Interview

Why is the AF not exploring/using ERP?

> The biggest problem is lack of leadership. There is no screaming zealot in the AF, but one would be needed throughout the entire time it took to implement a new ERP system.
>
> Time and money are also factors against ERP. Reengineering costs would be very high if the AF had to change many of its business processes.How interoperable are the different ERP software systems?

How interoperable are the different ERP software systems?

> Interoperability is question for the distant future.

Appendix 6. SSG Interview

What information do you have about what the DLA and other Services are doing with ERP?

The Navy researched, chose, and implemented four separate ERP pilots, and are currently trying to link the different pilots together.

What is the AF doing with regard to ERP?

The AF's official position (21 February 2003) was 'wait and see.' The AF thinks there may be other ways to achieve enterprise integration without using ERP.

Why is the AF not exploring/using ERP?

The AF has had some bad experiences with COTS failures. ILS-S tried to implement GOLD (Government Online Data) in 1996 to replace SBSS. It was ERP-like software (integrated, real-time, etc.). It was estimated to be a 65 percent match to AF supply processes, meaning that 35 percent customization was needed. Cost increases and schedule overruns led to the program being killed in 1999. The push for modernization has led the AF back to looking at COTS ERP/integrated software packages, especially with the improvements in the past couple of years.

It is estimated that there is an 80 percent match with any COTS ERP software package. The AF still questions how the gaps will be filled. The AF also has some unique processes that no software will ever be able to cover.

Implementing ERP is also a time consuming process, and the AF needs a solution now. The AF cannot afford to wait 5 years to see results.

No funding currently exists to test ERP.

There are no incentives to coordinate programs; the acquisition structure is not set up for coordination.

If the AF were to explore/use ERP technology, where would be the best place to test ERP?

> The AF has two programs they are trying to modernize that could possibly use ERP; only supply side though. Modernizing the ILS-S (base level supply, SBSS), and the stock control system (depot level, AFMC).

How interoperable are the different ERP software systems?

> Did not know if different systems are interoperable. Linkages will be difficult even with same vendor (SAP) when the system is customized or extended in any way. DoD interoperability will happen, somehow, if it is required.

Appendix 7. BearingPoint Contractor Interview

How interoperable are the various vendor software programs?

> Interoperability is too strong of a word. It is more an issue of interfacing. If the AF goes with a vendor besides SAP, interoperability will be possible.

What amounts of customization have the other services done?

> Do not know for sure at this time and will not know for a couple of months. Most are trying to use COTS as much as possible. They are not customizing the COTS code. Figures about 80-90 percent fit at the front end.

Are there any alternatives to ERP when the report says IPS?

> IPS is ERP. He figures the AF will eventually use ERP as the backbone with BOB like APS from Manugistics, and some additional add-ons for things like forecasting and demand analysis. No one package can handle all the different needs of the AF. It takes years to complete an implementation and vendors can add on capabilities as needs arise, so may be able to buy more from one vendor by the time the AF starts using ERP.

Where do you see the AF first using ERP?

> A depot (wholesale) pilot with possible parallel pilots for retail supply. Still waiting to complete the final report in August 2003.

Bibliography

Apicella, M. "Powering the Supply Links," *InfoWorld*, 23: 24-27 (24 December 2001).

"Army Wholesale Logistics Modernization Program (WLMP)." Excerpt from an unpublished article. n. pag. www.wlmp.com. 13 October 2000.

"Background Leading to WLMP." Excerpt from an unpublished article. n. pag. http://wlmpportalprod.wlmp.com. 25 January 2003.

Bedingfield, J. Director, Supply and Finance Information Systems, AF Program Executive Office for Command and Control and Combat Support Systems, Pentagon Washington DC. Telephone interview. 4 March 2003.

Bingi, P., M. Sharma and J. Godla. "Critical Issues Affecting ERP Implementation," *Information System Management*, 16: 7 (March 1999).

Caterinicchia, D. "NMCI Aids Navair ERP Rollout." Excerpt from an unpublished article. n. pag. http://www.fcw.com/fcw/articles/2002/1104/web-nmci-11-06-02.asp. 6 November 2002.

Coburn, J.G., General, Commander, Logistics Division, Army Material Command. Memorandum of Wholesale Logistics Modernization Program (WLMP). 22 March 2000.

Cross, S. and others. "SEI Independent Research and Development Projects." Unpublished Report No. CMU/SEI-2002-TR-023. October 2002.

"Customers: Government." Excerpt from an unpublished article. n. pag. http://www.seebeyond.com/customers/governmentCustomers.asp. 20 February 2003.

Davenport, T.H. Mission *Critical: Realizing the Promise of Enterprise Systems*. Boston: Harvard Business School Press, 2000.

---. "Putting the Enterprise into the Enterprise System," *Harvard Business Review*, 16:121-131 (July-August 1998).

Dittmer, J. ILS-S Program Manager, Chief, Supply Systems Division, HQ SSG/ILS. Gunter Annex AL. Telephone interview. 24 February 2003.

Eisenhardt, K.M. "Building Theories from Cast Study Research," *Academy of Management Review*, 14: 532-550 (1989).

Elliott, S. "Enterprise Architecture Integrates AF Systems," *Air Force News*. http://www.af.mil/news/Oct2002/100202459.shtml. 02 October 2002.

"Enterprise Application Integration." Excerpt from an unpublished article. n. pag. http://www.tibco.com/solutions/technology_solutions/eai/default.jsp. 20 February 2003.

"ERP for Navy." Excerpt from an unpublished article. n. pag. http://www.navsup.navy.mil. April 2000.

"ERP Overview." Excerpt from an unpublished article. n. pag. http://www.erpassist.com/pub/erp_overview.htm. 29 May 2002.

"ERP, SAP, and WLMP." Excerpt from an unpublished article. n. pag. http://wlmpportalprod.wlmp.com. 10 July 2002.

"ERP Software Evaluated: What Criteria Were Used." Excerpt from an unpublished article. n. pag. http://wlmpportal.wlmp.com. 25 January 2003.

Eyermann, R. "Transforming the Way AFMC Does Business," *The Leading Edge*, 44: 11-12 (June 2002).

"Future Logistics Enterprise: The Way Ahead." DoD. 3 June 2002.

"Global Airline Inventory Network." Excerpt from an unpublished article. n. pag. http://www.boeing.com/commercial. 4 June 2002.

"Global Combat Support System-Army." Excerpt from an unpublished article. n. pag. http://www.gcss-army.lee.army.mil/G-ARMY/PMGCSSARMY.htm. 2 September 2002.

Gossard, G. "Improving Inventory Performance and Bottom-Line Profits," *Evolving Enterprise*, (Spring 1998).

"Government." Excerpt from an unpublished article. n. pag. http://www.tibco.com/solutions/industry_solutions/government/default.jsp. 20 February 2003.

Hannaford, Steve. AFMC/LG. Wright Patterson AFB OH. Personal interview. 21 February 2003

Harrold, D. "How Manufacturing Benefits by Understanding ERP and IT," *Control Engineering*, 48: 26-35 (January 2001).

Hernandez, J. *The SAP R/3 Handbook*. New York: McGraw-Hill, 1997.

Hitt, L.M., D.J. Wu, and X. Zhou. "Investment in Enterprise Resource Planning: Business Impact and Productivity Measures," *Journal of Management Information Systems*, 19: 71-98 (January 2002).

Hoelscher, J. "Transforming the Depot Repair Business," *The Leading Edge*, 44: 16 (June 2002).

Jenson R.L. and R.I. Johnson. "The Enterprise Resource Planning Systems as a Strategic Solution*," Information Strategy: The Executive's Journal*, 15: 28-34 (1999).

Johnson, J.A. "Is Supply Chain Management the Same as ERP?" *Information Strategy: The Executive's Journal*, 17: 43-48 (Spring 2001).

Kann, J. "NAVSUP/NAVAIR SMART ERP Pilot Continues." Excerpt from an unpublished article. n. pag. http://www.navsup.navy.mil/lintest/janfeb02/smarterp.htm. 2002.

Koch, C. "The ABCs of ERP," *CIO Magazine*, http://www.cio.com/research/erp/edit/erpbasics.html. 7 February 2002.

Kreisher, O. "The Key to the Navy's Future: NAVAIR Set to Apply Network-Centric Warfare Tools to Management Process," *Sea Power*, 45: 95-98 (2002).

Kumar, V., B. Maheshwari, and U. Kumar. "Enterprise Resource Planning Systems Adoption Process: A Survey of Canadian Organizations," *International Journal of Production Research*, 40: 509-523 (2002).

Kwon, T. and R. Zmud. "Unifying the Fragmented Models of Information Systems Implemenatation," in *Critical Issues in Information Systems Research*. Ed Boland and Hirschheim. New York: John Wiley, 1987.

Legare, Thomas L. "The Role of Organizational Factors in Realizing ERP Benefits," *Information Systems Management*, 19: 21-42 (2002).

Levy, S. *Information Technologies in Universities: An Institutional Case Study*. Unpublished doctoral dissertation. Northern Arizona University, Flagstaff AZ, 1988.

Li, A. "Using Case Studies to Evaluate Technical Integration." Excerpt from an unpublished article. n. pag. http://www.serve.org/seir-tec/present/casestud/tsld026.htm. 27 February 2003.

"Lockheed Martin: Enterprise Resource Planning." Excerpt from an unpublished article. n. pag. http://www.it.lockheedmartin.com. 4 June 2002.

"Lockheed Martin to Support Andersen Consulting Defense Supply Chain Modernization Effort." Excerpt from an unpublished article. n. pag. http://www.lockheedmartin.com/news/articles/092800_1.html. 28 September 2000.

Louzek, R.R. *Evaluating Naval Air Warfare Center Aircraft Division (NAWCAD) Financial Management Practices in Preparation for Implementing ERP*. MS thesis, Naval Post Graduate School, Monterey CA, 2000.

Manoeuvre. "The Six Deadly ERP Sins." Excerpt from an unpublished article. n. pag. http://www.manoeuvre.com.au. 4 Oct 2001.

Merriam, S.B. *Case Study Research in Education: A Qualitative Approach*. San Francisco: Jossey-Bass Publishers, 1988.

Minahan, T. "Enterprise Resource Planning: Strategies Not Included," *Purchasing*, 125:112-127 (1998).

Money, A.L., DoD Chief Information Officer (CIO), Guidance and Policy Memorandum No. 12-8430. "Acquiring Commercially Available Software," 26 July 2000.

Morphy, E. "The Quest for Interoperability," *NewsFactor Network*. http://www.newsfactor.com/perl/story/20142.html. 4 December 2002.

Mowbray, T.J. "Preliminary Status: Enterprise Resource Planning Initiative," 25 January 2002.

Murray, B. "Navy Takes on Enterprise One Pilot at a Time," *Government Computer News*, 19: 9 (April 2000).

"mySAP Aerospace and Defense: Key Capabilities." Excerpt from an unpublished article. n. pag. http://www.sap.com/print/solutions/industry/aero-defense/keycapabilites/index.asp. 5 February 2003.

"mySAP Aerospace and Defense: Press Fact Sheet." Excerpt from an unpublished article. n. pag. http://www.sap.com/company/press/factsheets/industry/aerospace_defense_sept.asp. September 2002.

"Navy 'SMART ERP' Pilot Goes Live, Reaches Milestone," *NAVSUP News*. http://www.navsup.navy.mil/news/030110.jsp. 10 January 2003.

Onley, D.S. "Air Force Sets Final Plans for Enterprise Portal," *Government Computer News*. http://www.gcn.com/20_27/news/17038-1.html. 10 September 2001.

Palaniswamy, R., and T.G. Frank. "Enhancing Manufacturing Performance with ERP Systems," *Information Systems Management*, 17: 43-55 (2000).

---. "Oracle ERP and Network Computing Architecture: Implementation and Performance," *Information Systems Management*, 19: 53-69 (2002).

Ragowsky, A., and T.M. Somers. "Special Section: Enterprise Resource Planning," *Journal of Management Information Systems*, 19(1): 11-15 (2002).

Restel, J. "Case Study: Automated Material Tracking System." Excerpt from an unpublished article. n. pag. http://stsc.hill.af.mil/CrossTalk/2000/apr/restel.asp. April 2000.

Reynolds, S. "Background Paper on Enterprise Resource Planning (ERP) Systems." HQ SSG/ILSPR (LMI). 10 April 2001.

Robey, D., J.W. Ross, and M. Boudreau. "Learning to Implement Enterprise Systems: An Exploratory Study of the Dialectics of Change," *Journal of Management Information Systems*, 19: 17-46 (2002).

Rooney, C., and C. Bangert. "Scheduling in ERP Environment: Optimizing Batch Sizes," *Adhesives Age*, 44: 53-55 (May 2001).

Ross, J.W. "The ERP Path to Integration: Surviving vs. Thriving," *eAI Journal*. http://www.eaijournal.com/ERPIntegration/ERPPath.asp. 1999.

Saccomano, A. "More than Manufacturing," *Traffic World*, 256: 46 (1998).

"Scoopsoft Development." Excerpt from an unpublished article. n. pag. http://scoopsoftware.com. 6 June 2002.

Shtub, A. "A Framework for Teaching and Training in the Enterprise Resource Planning (ERP) Era," *International Journal of Production Research*, 39: 567-576 (2001).

Sjoberg, G. and others. "The Case Study Approach in Social Research," in *A Case for Case Study*. Ed J. Feagin, A. Orum, G. Sjoberg. Chapel Hill, NC: University of North Carolina Press, 1991Stake, R.E. 1995. The Art of Case Research. Newbury Park CA: Sage Publications.

"SMART ERP Pilot to 'Go Live' Dec 1." http://www.sd.fisc.navy.mil/News/News-Releases/NR02-41.html. 20 November 2002.

"SMART/ERP Workforce Overview." Excerpt from an unpublished article. n. pag. http://www.navsup/navy.mil. 25 January 2002.

Songini, M.L. "Navy Embarks on SAP-Based Supply-Chain Mission." http://www.computerworld.com/softwaretopics/erp/story/0,10801,56109,00.html. 10 January 2001.

---. "Navy Embarks on Supply-Chain Mission: Military says SAP System Will Cut $65 Million in Annual Procurement Costs," *Computerworld*, 35: 7 (2001).

"Strategic Business Process Reengineering Initiative: Best Practices for Enterprise Software Agreements Within DoD and the Corporate World." Report, 14 September 1999.

"The Study of the Modernization of the Stock Control System." Unpublished Draft to MSG/SLE, HQ AFMC, Wright Patterson AFB OH. 31 January 2003.

"Summary of the ERP Efforts." Excerpt from an unpublished article. n. pag. http://wlmpportalprod.wlmp.com. 20 February 2003.

Tellis, W. "Application of a Case Study Methodology," *The Qualitative Report,* 3: n. pag. (September 1997).

---. "Introduction to Case Study," *The Qualitative Report*, 3: n. pag. (July 1997).

Teltumbde, A. "A Framework for Evaluating ERP Projects," *International Journal of Production Research*, 38: 4507-4520 (2000).

"TIBCO Enterprise Application Integration Solutions." Excerpt from an unpublished article. n. pag. www.tibco.com. September 2002.

US Army Material Command. *Enterprise Resources Planning (ERP) / Product Data Management (PDM) Integration Team (EPIT) Report*. 12 April 2002.

Van Hook, L. "Logistics Division: Supporting the War on Terrorism," *The Leading Edge*, 44: 6-7 (June 2002).

Vicon, T. BearingPoint contractor working on SCS Modernization Report. Telephone interview. 27 February 2003.

Vrosh, A. "SSG Announces Air Force-wide Enterprise License for Oracle," *Air Force News*. http://www.af.mil/news/Jun2000/n20000622_000948.html. 22 June 2000.

Wholesale Logistics Modernization Program: U.S. Army Material Command." Excerpt from an unpublished article. n. pag. www.wlmp.com. 5 January 2003.

Wilczynski, B. "Enterprise Resource Planning (ERP) and Data Integration: Briefing for Data Administration Council." 18 February 2000.

Wright, D. Business Manager and Program Analyst at MSG/SLE, Wright Patterson AFB OH. Telephone interview. 27 February 2003.

Yin, R.K. *Applications of Case Study Research*. Newbury Park CA: Sage Publishing, 1993.

---. *Case Study Research: Design and Methods* (1st Edition). Beverly Hills CA: Sage Publishing, 1984.

---. *Case Study Research: Design and Methods* (Rev. Edition). Newbury Park CA: Sage Publishing, 1993.

---. *Case Study Research: Design and Methods* (2nd Edition). Thousand Oaks CA: Sage Publishing, 1994.

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14. ABSTRACT

Over time, the Air Force (AF) built customized legacy logistics data and information systems, which have evolved into an inflexible network of obsolete systems that are costly to maintain and upgrade, and struggle to share data in a timely and coherent manner. The Department of Defense (DoD), to include the Defense Logistics Agency (DLA), the US AF, the US Army, and the US Navy, have all recognized the need to modernize and integrate their legacy systems to improve warfighter support. The DLA, the US Army, and the US Navy all see Enterprise Resource Planning (ERP) technology as a commercial best practice, and consequently as the best way to replace their legacy systems. They are all in the process of implementing ERP pilot tests. The AF has adopted a 'watch and learn' position on ERP, while continuing to upgrade its legacy systems piecemeal.

This thesis first seeks to understand what ERP is and how it is being used. A case study analysis of the DLA, the US Army, and the US Navy ERP pilot tests is used to explore how and why the DoD organizations are using ERP, and to see if it is time for the AF to formally explore ERP technology to replace its legacy logistics systems.

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