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A "Big Bang" versus a "Small Bang" Approach: A Case Study of the Expeditionary Combat Support System (ECSS) and the Maintenance, Repair, and Overhaul Initiative (MROi)

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Abstract

In 2003, the United States Air Force embarked on one of the largest and most comprehensive logistical transformation to delineate the logistics community's strategy for supporting the warfighter. A key aspect of this campaign plan was to leverage information technology through an enterprise resource planning (ERP) solution called the Expeditionary Combat Support System (ECSS), a "big-bang" approach. In early 2012, the ECSS program was cancelled mainly due to uncontrollable increases in costs and schedule overruns. In late 2012, the Air Force Sustainment Center (AFSC) launched the Maintenance, Repair, and Overhaul initiative (MROi), a "small-bang" approach, to increase enterprise visibility and efficiency across all three Air Logistics Complexes and Aircraft Maintenance and Regeneration Group. Additionally, MROi should fill some of the gaps deferred by ECSS. MROi is a means to salvage, correct, and continue the work started during the ECSS project. AFSC attempts to transform itself into a more capable organization thru MROi while providing savings to the taxpayers from resulting improvements in efficiencies. The MROi team attempts not to ignore lessons learned from ECSS; however, MROi is delayed by acquisition category determination, system implementation source selection, and network architecture evaluation, which are out of their control. Critical success factors, antecedents, and theories were discovered that can help develop a framework that may be of great importance to the government.

To my family and adopted family, especially my son and daughters, for giving me the limitless inspiration and support throughout the AFIT experience. To my trusted and loyal friends.

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George B. Lafiguera

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List of Acronyms

A4N	Systems Integration Division
ACAT	Acquisition Category
AF/IL	Air Force Deputy Chief of Staff, Installation and Logistics
AF/A4I	Air Force Directorate of Transformation
AFIT	Air Force Institute of Technology
AFLCMC	Air Force Life Cycle Management Center
AFMC	Air Force Materiel Command
AFSC	Air Force Sustainment Center
ALC	Air Logistics Complex
AMARG	Aircraft Maintenance Regeneration Group
BPR	Business Process Reengineering
CE	Change Efficacy
CF	Contributing Factor
CITI	Collaborative Institutional Training Initiative
cMRO	Complex Maintenance, Repair and Overhaul
CBERP	Cloud-based Enterprise Resource Planning
COA	Course of Action
COTS	Commercial off-the-shelf
CSE	Computer Self-efficacy
CSFs	Critical Success Factors
DoD	Department of Defense

DOTMLPF	Doctrine, Organization, Training, Material, Leadership & Education, Personnel, and Facilities
EBSCO	Elton B. Stephens Company
ECSS	Expeditionary Combat Support System
eLog 21	Expeditionary Logistics for the 21st Century
ERP	Enterprise Resource Planning
GAO	Government Accountability Office
IT	Information Technology
KDS	Knowledge Domain Series
KPMG	Klynveld Peat Marwick Goerdeler
KTS	Knowledge Transfer Site
MAIS	Major Automated Information System
MDA	Milestone Decision Authority
MROi	Maintenance, Repair, and Overhaul Initiative
MS	Milestone
OC-ALC	Oklahoma Air Logistics Complex
OE	Organizational Efficacy
OGRD	Organizational Readiness for Change
OJT	On-the-job Training
OO-ALC	Ogden Air Logistics Complex
PII	Personally Identifiable Information
PO	Program Office
PRM	Performance Reference Model

RC	Root Cause
SCM	Supply Chain Management
SDDP	Service Development and Delivery Process
SE	Self-efficacy
SI	System Integration
SME	Subject Matter Expert
USAF	United States Air Force
WPAFB	Wright Patterson Air Force Base
WR-ALC	Warner Robins Air Logistics Complex

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I. Introduction

This case study examines the planning and implementation of the United States Air Force's (USAF) Expeditionary Combat Support System (ECSS), a key part and a critical enabler of the Expeditionary Logistics for the 21st Century (eLog21) transformation and, more specifically, the lessons learned from the failed ECSS implementation. Furthermore, the risks involved and implementation plan of ECSS will be compared to the current USAF logistics program to increase enterprise visibility and efficiency called Maintenance, Repair, and Overhaul initiative (MROi). This section contains an introduction to ECSS and MROi, problem statement and purpose, methodology, and assumptions of the research.

ECSS and MROi

In 2003, the USAF embarked on a logistical transformation called eLog21. eLog21 was to delineate the logistics community's strategy for supporting the warfighter and was designed to fully integrate the enterprise view of all logistics processes worldwide by linking supply, maintenance, and transportation processes in support of an expeditionary force (Elliott, 2005). Logisticians were expected to use modern technologies to replace outdated logistics computer systems or legacy systems and were supposed to use lean process improvements to eliminate waste and non-value added processes.

Two essential foundations were needed to be built by eLog21 to move to a more streamlined Air Expeditionary Force view of logistics. The first foundation was an enterprise view of logistics. Supply chain processes will transition away from the organizational stovepipes

of commodity-focused processes to a non-commodity specific based system. The second foundation was architecture and governance of the design, implementation, and sustainment phases of the Air Force Logistics Transformation. The Deputy Chief of Staff, Installation and Logistics (AF/IL), established the Directorate of Transformation (AF/A4I) to develop and implement transformation policy and planning across all USAF Major Commands (USAF, 2003).

A key aspect of the eLog21 campaign plan was to leverage information technology through the ECSS (USAF, 2015). ECSS was designed as an enterprise resource planning (ERP) tool that would have replaced hundreds of legacy systems and incorporated many resource planning activities in logistics. In addition, ECSS would have enabled end-to-end transformation of worldwide logistics processes for the USAF and was critical to shaping the future for the USAF. Furthermore, ECSS was expected to deliver nearly real-time visibility, increased availability of mission-critical assets, and synchronized logistics planning and execution while reducing overall costs. Additionally, ECSS was predicted to be the foundation for realizing the eLog21 transformation objectives of increased availability by 20 percent and reduced operational and support costs by 10 percent. Moreover, ECSS would have tracked and accounted for all IT systems and their expenditures (Dunn, 2006).

ECSS was one of the largest and most comprehensive business transformations ever envisioned by the USAF. It was a significant part and vital to the success of eLog21 with twelve basic capabilities. These capabilities were advance planning and scheduling; material management, contracting, and logistics finance; configuration and bill of materials; repair and maintenance; product life-cycle management; customer relationship management and order management; distribution and transportation; decision support; facilities management; quality

control; document management; and budgeting. These capabilities were projected to add value by reducing inventories while improving availability, decreasing maintenance cycles, eliminating clerical efforts for financials, and were designed to produce timely leaders' decision making, enhance allocation of resources to demand, improve financial management, and increase product and data quality (White & Bergdolt, 2007). In early 2012, the ECSS program was cancelled mainly due to uncontrollable increases in costs and schedule overruns (Levin & McCain, 2014).

In late 2012, the USAF, mainly Air Force Sustainment Center (AFSC), launched MROi to improve or increase enterprise visibility and efficiency and to fill some of the gaps deferred by ECSS. Furthermore, MROi is a reduced version of ECSS and a more focused grouping of logistics systems and processes. The AFSC organic depot maintenance enterprise does not have the capability to view items in repair within and across all Air Logistics Complexes (ALCs). This new capability will help USAF leaders and decision makers optimize the assignment of resources, workloads, and unused capacity through "what-if" analysis. "What if" analysis enables the leaders and managers to identify and predict resources, workloads, and capacity requirements in a given situation (Kaplan & Cooper, 1998).

MROi is evolutionary. MROi is an incremental approach that will help organizational members, vendors, and consultants learn during the ERP transition. Most importantly, it will give employees time to comprehend and assimilate to the change. Boudreau and Robey (1999) define this as a "small-bang" approach to an ERP solution. (Boudreau & Robey, 1999).

MROi will assist in decreasing re-work in repair processes due to the use of substandard legacy processes and systems that do not integrate the core MRO capabilities of planning, scheduling, and executing maintenance. Furthermore, MROi promises to provide the ability to reduce flow days, improve throughput, increase on-time delivery, and improve aircraft and

weapon systems availability. Most importantly, MROi will provide organic depots with an integrated capability for planning, scheduling, and executing maintenance to support agile planning, optimized workload assignment and resource allocation, and integrated quality (Bury, 2013).

MROi performance reference model (PRM) identified three core mission functions or efforts. They are planning, scheduling, and executing. These core mission areas are based on functional maintenance activities and closely align with the maintenance actors performing the work across ALCs (Crane & Bury, 2013). Some of the actors are maintenance planners, master schedulers, maintenance technicians, and production chiefs. These three core mission functions were aligned with four distinct capabilities to facilitate Doctrine, Organization, Training, Material, Leadership & Education, Personnel, and Facilities (DOTMLPF) implementation plan. These four capabilities, which are shown in Figure 1, are:

1. Standardized, Auditable, Enterprise Visible Work Center
2. Integrated Engineering Support and Supply Support for Maintenance (Mx)
3. Optimized Mx Supportability
4. Agile and Consistent Mx Decision Capability

Implementing all the capabilities requires both non-material and material components and will satisfy critical needs such as allocation of resources (people, equipment, and facilities); integrated quality with maintenance processes (reduce re-work time, reduce re-work costs, and reduce re-work work in progress); planning, scheduling, and execution (reduce flow day variance, increase on-time delivery or due date performance, decrease work-scoped job cost variance, decrease plan change variance, decrease schedule change variance, and increase throughput); and auditable maintenance processes and transactions (Bury, 2013).

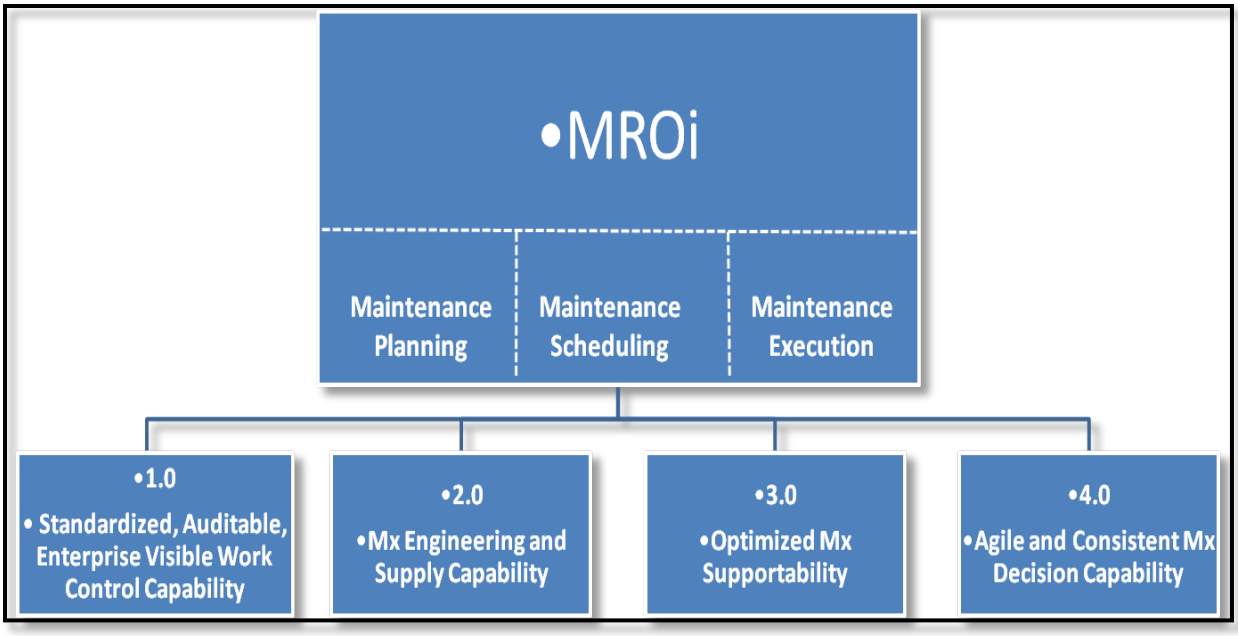

Figure 1: DOTMLPF Work Breakdown Structure (Bury, 2013)

Problem Statement and Purpose

ECSS was planned as a commercial off-the-shelf based system and was expected to leverage ERP IT system as its primary system. ECSS was supposed to integrate financial, manufacturing, distribution, and other business functions in a single technology solution. Most importantly, ECSS was supposed to enable a seamless flow of information across an organization using a comprehensive set of interconnected modules. ECSS was designed to create the standardization of business processes and tools across the enterprise or supply chain, regardless of program or site. However, the ECSS Program Office (PO) did not have the authority over all the maintenance and/or business processes involved. As a result, buy-in from stakeholders and subject matter experts (SMEs) was not achieved. Additionally, needed process improvements were not accomplished.

ECSS was revolutionary because it was implementing multiple ERP modules simultaneously in the enterprise. Moreover, ECSS was a rapid implementation approach of an organizational change in the USAF. Therefore, ECSS can be categorized as a "big-bang" approach to an ERP solution (Boudreau & Robey, 1999).

Aronin, Bailey, Byun, Davis, Wolfe, Frazier, and Bronson (2011) identified five principal causes of ECSS cost and schedule overruns. These were insufficient ERP expertise, data importation, contractor reporting shortfalls, insufficient understanding of ECSS launch problems, and the complexity of ECSS implementation across the USAF enterprise. ECSS had problems from the start. The first problem was System Applications and Products protested the contract award to Oracle in November 2005. The second problem was IBM protested the system integration contract awarded to Computer Science Corporation. The third problem was ECSS PO decided to switch to an all-Oracle product, even after the original Oracle bid identified other software packages were needed from other software companies. The fourth problem was that the Milestone (MS) B reschedules were not shown or reported in any of the ECSS schedules. Moreover, "fourth estate" problems, a collection of outside forces or variabilities (e.g., human factors), added to the reschedules of MS B and cancellation of ECSS (Aronin, et al., 2011).

Levin and McCain (2014) identified that ECSS failed, because it lacked a well-defined objective and organizational resolve to execute changes in its core businesses processes, which was vital to assimilating ECSS into the enterprise. This resulted in the violation of crucial guidelines and best practices for information technology acquisition, such as Section 1072 of the FY2010 National Defense Authorization Act – Business Process Reengineering (BPR). BPR is defined as the logical approach of evaluating process weaknesses, identifying gaps and implementing opportunities to streamline and improve these processes, and create a solid

foundation for success in changes to DOTMLPF (Levin & McCain, 2014). Furthermore, Levin and McCain's review focused on three significant contributors to the failure of the ECSS program. They were the USAF's cultural resistance to change, lack of leadership to implement needed changes, and inadequate mitigation of risks identified at the beginning of the procurement. All of these factors lead to several reschedules, cost overruns of over $1 billion, and ultimately the cancellation of the ECSS program (Levin & McCain, 2014).

In 2007, Mr. Tom Hamilton, ECSS program manager, identified ECSS as one of the largest and most comprehensive business transformations ever envisioned by the USAF. This was a risk not properly mitigated by the ECSS PO. Moreover, the Government Accounting Office (GAO) recommendations, lessons learned from the Navy's four ERP pilot, guidance from DoD SMEs, and an audit by Klynveld Peat Marwick Goerdeler (KPMG), a global accounting firm, were available and explored by the ECSS PO (Hamilton, 2007). Nevertheless, issues, risks, and actions taken by the Navy and industry were not properly identified and used. While MROi is not of the same scope as ECSS, lessons learned from ECSS are relevant. MROi has already been "adopted," and therefore plans for innovation are currently in the development phase.

The purpose of this study is to address how well ECSS lessons learned are being applied by MROi decision makers, stakeholders, and SMEs to identify and mitigate potential risks that may result in increased costs and schedule overruns ultimately leading to program failure. The following research question and investigative questions are used to guide the research:

Research Question:

How are the MROi leadership, planners, and SMEs applying lessons learned from ECSS to eliminate or mitigate risks for potential cost increase and schedule overruns that may lead to MROi failure?

Investigative Questions:

1. What are the critical elements of a successful ERP adoption and implementation?

2. What root causes, critical factors, elements, and/or issues contributed to the failure of ECSS?

3. Has the MROi team encountered the same root causes, critical factors, elements, and/or issues?

4. How did the MROi team mitigate these risks?

Methodology, Assumptions, and Limitations

Investigative questions can be answered by collecting archival data from briefings, official and public documents, journals and literatures, as well as structured and semi-structured interviews of the ECSS PO, MROi PO, contracting officer, and other SMEs. Furthermore, qualitative and contextual analyses will be used in this case study. Additionally, interviews may be conducted in person, via telephone, or electronic mail because of limited funding and inability to travel. Moreover, memorandum, e-mail correspondences, database, meeting minutes, reports, contractual documents, internal records, observations, and field notes will be examined in this case study. Most importantly, an in-depth analysis, evaluation, and comparison of ECSS and MROi implementation plans will be performed.

A limitation of this case study is that it will not focus on the technical aspects of ECSS, MROi, and their processes. Additionally, the researcher limits stakeholders and SMEs to employees for this case study because of limited time and funding. Moreover, researcher's use of the Complex Maintenance, Repair and Overhaul (cMRO) tool was limited due to network issues. Furthermore, case study approach limitations will be further discussed in Chapter 3.

Summary

Chapter 2 contains a literature review. The research methodology and data collection sources are detailed in Chapter 3. The data collected in the case study are presented and analyzed in Chapter 4. Data collected will distinguish critical elements, root causes, and/or issues that contributed to the failure of ECSS and ascertain if the MROi team encountered them. Lastly, Chapter 5 addresses conclusions and recommendations.

II. Literature Review

Chapter Overview

The purpose of this chapter is to provide an extensive literature review relevant to this research effort. The author found 38 articles pertinent to this case study. Additionally, these 38 articles were identified through a computer search database of published journals, reports, and conference proceedings in different industries such as aviation, manufacturing, telecommunications, transportation, footwear, pharmaceutical, nutritional, marketing, automotive, environmental, finance, medical, energy, information technology (IT), air pollution, dust collection, semi-conductor, and other significant supply chain management functions in the continents of Europe, Asia, North America, South America, and Australia.

Critical Success Factors and Process Theory

At the start, the researcher used key words "successful implementation of enterprise systems" or "successful adoption of enterprise systems" using Google Scholar® and found approximately 2,040 references. The list shows the article written by Nah, Lau, and Kuang (2001) twice and in the top two. Most importantly, this is the most cited article. Nah et al. (2001) discussed eleven critical factors for successful implementation of enterprise systems. Then, the researcher examined the next 18 articles on the list and nine related articles. Authors from these 38 articles identified four to 24 Critical Success Factors (CSFs). Researcher performed content analysis and narrowed down the CSFs to 11 relevant CSFs. They are monitoring and evaluating of performance; influential project champion; top management support; clear goals and objectives; user buy-in, involvement, training and education; strategic IT planning; teamwork and team composition; vendor support and performance; business process

reengineering; effective communication; and change management. These CSFs are explained in this section. All 28 articles with their corresponding CSFs are shown in Table 1.

Table 1: CSFs and Process Theory Literature Review Findings

	CRITICAL SUCCESS FACTORS										
SOURCES	Monitoring and Evaluating of Performance	Influential Project Champion	Top Management Support	Clear Goals and Objectives	User Buy-In, Involvement, Training, and Education	Strategic IT Planning	Teamwork and Team Composition	Vendor Support and Performance	Business Process Reengineering	Effective Communication	Change Management
Akkermans and Van Helden, 2002		x	x	x			x	x			x
Aksu, 2001									x		
Aladwani, 2001					x		x			x	x
Al-Mashari, Al-Mudimigh, and Zairi, 2003				x	x	x		x	x	x	
Ara and Al-Mudimigh, 2011											x
Bernroider and Koch, 2001			x	x							
Bingi, Sharma, and Godla, 2015			x		x	x	x		x		

	CRITICAL SUCCESS FACTORS										
SOURCES	Monitoring and Evaluating of Performance	Influential Project Champion	Top Management Support	Clear Goals and Objectives	User Buy-In, Involvement, Training, and Education	Strategic IT Planning	Teamwork and Team Composition	Vendor Support and Performance	Business Process Reengineering	Effective Communication	Change Management
Bisogno, Calebrese, Gastaldi, and Ghiron, 2016	x								x		
Boshale and Kant, 2016					x						
Clarke and Manton, 1997	x	x	x				x			x	x
De Toni, De Zan, and Battistella, 2016							x			x	x
Gargeya and Brady, 2005	x	x	x	x	x	x	x	x	x	x	x
Grant, 2016									x		
Hernaus, Vuksic, and Stemberger, 2016			x						x		
Huang and Yasuda, 2016				x					x		x
Holland and Light, 1999	x			x						x	

	CRITICAL SUCCESS FACTORS										
SOURCES	Monitoring and Evaluating of Performance	Influential Project Champion	Top Management Support	Clear Goals and Objectives	User Buy-In, Involvement, Training, and Education	Strategic IT Planning	Teamwork and Team Composition	Vendor Support and Performance	Business Process Reengineering	Effective Communication	Change Management
Hong and Kim, 2002	x										x
Hwang, 2005			x		x				x	x	
Iden, 2012			x								
Khosravi, 2016									x		
Kotorov, 2003			x						x		
Lau, Nakandala, Samaranayake, and Shum, 2016					x				x	x	
Markus and Tanis, 2000	x							x	x		
Nah, Lau, and Kuang, 2001	x	x	x	x	x	x	x	x	x	x	x
Remus, 2007			x	x		x			x	x	

	CRITICAL SUCCESS FACTORS										
SOURCES	Monitoring and Evaluating of Performance	Influential Project Champion	Top Management Support	Clear Goals and Objectives	User Buy-In, Involvement, Training, and Education	Strategic IT Planning	Teamwork and Team Composition	Vendor Support and Performance	Business Process Reengineering	Effective Communication	Change Management
Sharif, 2005									x		
Somers and Nelson. 2001		x	x	x	x			x			
Umble, Haft, and Umble, 2003	x		x	x	x	x	x				x

Several articles used Process Theory and/or Organizational Readiness for Change (OGRD) Theory, also called organizational readiness theory, as the framework for the study of adoption or implementation of enterprise systems or Enterprise Resource Planning (ERP) in supply chain management (SCM). A theory is an introspective and logical type of abstract or generalized thinking, or the results of a generalized thinking. Furthermore, a theory provides a descriptive structure for some observation and follows a number of possible hypotheses that can be tested in order to provide support for, or challenge, the theory (Eisenhardt, 1989; Eisenhardt & Graebner, 2007; Nah et al., 2001; Weiner, Lewis, & Linnan, 2009).

Process theory is a commonly used form of scientific research study of ERP adoption, post-adoption, and incorporation phases in SCM. Process theory is when occurrences are said to be the product of certain inputs leading to some outcome or output state, succeeding a set of processes. Some of the theories that fall into this category are expectancy theory, equity theory, goal-setting theory, life cycle theory, teleological theory, and dialectic theory (Kumar, Maheshwari, & Kumar, 2002; Nah et al., 2001; Robey, Ross, & Boudreau, 2002).

Eleven significant CSFs that are vital to ERP adoption and post-adoption phases are monitoring and evaluation of performance; influential project champion; top management support; clear goals and objectives; user buy-in, involvement, training and education; strategic IT planning; teamwork and team composition; vendor support and performance; business process reengineering; effective communication; and change management.

Monitoring and Evaluating of Performance.

Crucial areas of functionality should be identified, monitored, and evaluated during all phases of the ERP system implementation (Gargeya & Brady, 2005). Some of the critical areas found during the literature review were information availability, information quality, standardization, inventory management, and on-time delivery. Information availability denotes the changes in the accessibility of integrated real-time information from the ERP system. Information quality represents the changes in the availability of consistent and reliable information from the ERP system. Standardization signifies the streamlining and rationalization of business processes, as well as information flowing through the enterprise. Inventory management indicates the changes in the inventory management processes that lead to sizeable reductions in inventory holdings, increased inventory turnover, and efficient control over inventories. On-time delivery denotes changes in the order management or order cycle that

facilitate on-time delivery of products and/or services to customers (Holland & Light, 1999; Hong & Kim, 2002).

Monitoring and evaluating these crucial areas of functionality can be achieved using performance measures or value-added metrics based on the organization's type of business and should be completed regularly. Additionally, frequencies may change in relation to the phase of the ERP project. Moreover, these metrics should be easily measurable, effortlessly visible, well-defined, widely understood, and readily available for all users (Stahl, 2014). Furthermore, the flexibility of logically changing these metrics should be available to the organization (Kazi, 2015; Stahl, 2014).

Milestones and targets are important to follow during ERP project development (Nah et al., 2001). Achievements and project progress should be measured against specified project targets, and exit criteria should be well defined (Kaplan & Cooper, 1998). Additionally, the progress of the ERP project should be actively monitored through set milestones and goals (Umble, Haft, & Umble, 2003). Furthermore, criteria such as completion dates, costs, and quality should be used throughout the ERP system adoption, post-adoption, and incorporation of the enterprise (Bisogno, Calabrese, Gastaldi, & Ghiron, 2016; Nah et al., 2001).

Influential Project Champion and Top Management Support.

A very important step early in the ERP system adoption, post-adoption, and strategic planning stages is to obtain the involvement and support of an influential project champion with funding-authority. Generally, the type of power and authority necessary for the adoption and incorporation of the ERP system depends on the size of the organization or enterprise. Normally, the project champion resides with the top management of an organization (Akkermans & Van Helden, 2002; Kazi, 2015).

The support of top management with the appropriate authority and influence is critical to the adoption and post-adoption of an ERP system (Gargeya & Brady, 2005). Top management will more likely link the organizational and ERP strategies together to get the most out of the enterprise's investment (Clarke & Manton, 1997). Additionally, they are readily able to secure the funding or any resources required. Moreover, an influential leader in a position of authority can also task the involvement and cooperation of any sub-organization to collaborate on the adoption and post-adoption of the ERP project. Furthermore, someone with this type of authority can be very beneficial to the overall adoption and post-adoption of the ERP system (Levin & McCain, 2014; Nah et al., 2001).

The ERP system may need updates and/or expansions to absorb new managerial ideas and technology to produce new or updated capabilities or requirements. Top leader involvement can help prioritize resources allowing the system to have more powerful abilities to meet these new ideas and requirements. Furthermore, leaders who develop innovative solutions and create a collaborative culture will enable ERP project completion, which will result in a competitive advantage (Hwang, 2005; Iden, 2012). In addition, top management support and involvement can help leaders learn the ERP system in detail. This increased knowledge of ERP system capabilities and limitations enables leaders to make effective "what-if" decisions for the enterprise (Somers & Nelson, 2001; Umble et al., 2003).

Clear Goals and Objectives.

The literature review revealed clear goals and objectives are critical parts of a successful ERP adoption and post-adoption. Clear goals and objectives ensure that the ERP system will be implemented according to the planned scheme, and the system is able to smoothly connect every logistical or SCM function of the enterprise (Al-Mashari, Al-Mudimigh, & Zairi, 2003).

Misalignment of the enterprise goals and objectives, as well as ERP project goals, may lead to early obsolescence of the project, user frustration, customer dissatisfaction, and funding waste (Kazi, 2015; Remus, 2007). Furthermore, features and functionality of a new ERP process should contribute to the success of enterprise goals and objectives. Managers and leaders must abstain from developing an ERP system in terms of cost savings (tangible benefit) alone, but instead should focus on the business benefits and other intangible benefits that can be gained from this ERP system (Levin & McCain, 2014; Somers & Nelson, 2001).

A well-defined business plan and vision will help guide the direction of the ERP project and is needed throughout the ERP life cycle. The business plan should contain at a minimum the proposed strategies, tangible benefits, resources, costs, risks, timeline, and intangible benefits. All of these will help focus on the enterprise benefits. Additionally, there should be a justification of the investment based on a problem not a "want" (Levin & McCain, 2014; Nah et al., 2001). Moreover, the problem identified and changes made should be tied directly to the direction of the company. Furthermore, goals and benefits should be identified, actively tracked, and reported to the organization (Levin & McCain, 2014; Somers & Nelson, 2001; Umble et al., 2003).

User Buy-in, Involvement, Training, and Education.

Users are important stakeholders and SMEs during the ERP life cycle (Nah et al., 2001; Umble et al., 2003). Normally, stakeholders and SMEs may be customers or employees. Employees are familiar with the processes used in the organization; therefore, managers and leaders should ask for a limited number of employees to be part of the cross-functional team for the ERP system (Aladwani, 2001; Nah et al., 2001).

Employees or volunteers are part of the social network of personnel and provide an advantage for organizational adoption, acceptance, routinization, assimilation, and incorporation of the ERP system (Aladwani, 2001). Moreover, the structure of social interactions enhances access to valued resources, such as important business and other processes information. Furthermore, organizational behavior research has examined how user or employee involvement can influence employees' attitudes, perceptions, behaviors, and even job outcomes (Bingi, Sharma, & Godla, 2015). Additionally, employee buy-in and involvement during ERP project adoption and incorporation can improve communication on the production floor and in the enterprise (Bhoshale & Kant, 2016).

User training and education is where knowledge integration happens in a learning environment. Knowledge is shared across organizations and enables employees to better perform their task. Moreover, user training and education can be formal (e.g. classroom) or informal (e.g. on-the-job training or OJT) (Gargeya & Brady, 2005). Additionally, classroom exercises should encourage employee interaction and academic freedom. Training documentation should be kept for all employees and managers. Some organizations may have a contractor as a SME to teach or train the employees (Lau, Nakiandala, Samaranayake, & Shum, 2016).

Knowledge integration is a combination of specialized knowledge to create new knowledge and to improve enterprise capabilities (Markus & Tanis, 2000). An example of knowledge integration is where program or functional managers, who have technical knowledge, use this technical knowledge to address important enterprise issues and positively influence the ERP project. Furthermore, mutual trust and influence between stakeholders and SMEs increase

during user training and education (Motwani, Mirchandani, Madan, & Gunasekaran, 2002). Additionally, recurring refresher training may be necessary.

In some cases, user training and education is critical because ERP systems may redefine jobs or responsibilities and make traditional department boundaries vague or confusing for some employees (Aladwani, 2001). Unlike the independence among the legacy systems, the operations of the ERP system in a supply chain will have an immediate impact on upstream and/or downstream SCM operations. Operational errors that occur in one department can result in potential disasters in other departments or a total shut down of the supply chain (Al-Mashari et al., 2003).

A high degree of acceptance should be a target during user education and training. This can be achieved by allowing users to work in a familiar environment, as well as the use of interactive user manuals and structured knowledge tests (Bradford & Florin, 2003). For example, the USAF uses Microsoft Office®, and ERP integration with this operating system may help users work in a recognizable situation. Moreover, reskilling and professional development of the IT workforce is critical to the successful incorporation of the ERP system. Additionally, on-site support manuals for staff, as well as managers and support organizations (e.g. help desk, on line users' manuals, videos, and etc.) are critical to meet users' needs during ERP total life cycle (Nah et al., 2001).

Strategic IT Planning.

Strategic IT planning is about combining software development with organizational goals, managerial objectives, users' needs, and understanding the requirements of the enterprise (Umble et al., 2003). Additionally, strategic IT planning is the process of identifying a portfolio of computer-based applications that will support an enterprise in business plan execution and

business goals realization. Some of the organizational goals mentioned in the academic journals were fast and accurate customer service, cost-effective processes, and efficient SCM functions (e.g. transportation, shipping, disaster relief functions, outsourcing, vendor support, etc.). Furthermore, strategic IT planning may include the specification of databases and systems to support those applications. In addition, it may embrace the selection of a straightforward application from an existing list of possibilities that would best fit the enterprise's current and future needs. Moreover, it may entail the discovery of new applications with the potential to create an advantage over competitors (Nah et al., 2001; Wong, 2005).

Time may be a constraint for some of the organizations because "time is money" or "time is life," which requires an ERP system that can react quickly and accurately (Strakos & Chin, 2014). Additionally, ERP system's internal and external operational influences, critical functions and capabilities, and other software and hardware best practices should be considered (Kazi, 2015). Moreover, the overall ERP system design and architecture should be established, reviewed, and tested before actual deployment. Simulation may replace testing (Nah et al., 2001).

Teamwork and Team Composition.

Teamwork is very important and, if planned correctly, happens in every phase of the ERP system life cycle (Akkermans & Van Helden, 2002). One example is during knowledge sharing. Knowledge sharing facilitates learning and knowledge development through a process of coordinated interaction among individuals at different levels of the enterprise. Additionally, the ability to share knowledge enhances an organization's tendency to change as transparent data access empowers individuals and knowledgeable workers to strengthen one another's expertise. It is also possible that competitive controversy within generally competitive groups can result in

greater openness, knowledge, and understanding (Aladwani, 2001; De Toni, De Zan, & Battistella, 2016; Nah et al., 2001).

Team composition should consist of the finest people in the organization with internal commitment to the goals and objectives of the organization (Bingi et al., 2015). Furthermore, a cross-functional team is critical and should have a mix of consultants, internal staff, employees, and managers to develop technical and business knowledge essential to the success of the ERP system. Team members should be assigned full-time to the ERP project and should be located as far as possible from their regular day-to-day responsibilities (Robey et al., 2002). Furthermore, the team members should be co-located to facilitate working together. Moreover, team members should be given compensation and incentives for successfully incorporating the ERP system in the enterprise (e.g. promotions, temporary promotions, cash awards, etc.) (Argyris & Kaplan, 1984). Likewise, empowerment of the project team to implement solutions on the spot captures creativeness in the enterprise's supply chain management functions.

Vendor Support and Performance.

Vendor support and performance in software development, testing, and troubleshooting are crucial in all phases of the ERP system implementation (Markus & Tanis, 2000). Additionally, the overall ERP system architecture should be established before incorporation – taking into account the critical requirements of the enterprise. This will immensely preclude reconfiguration at every stage of the ERP project. Furthermore, troubleshooting errors will help achieve seamless diffusion of the ERP system in the enterprise. Therefore, the vendors, consultants, stakeholders, and SMEs should work together to resolve any ERP system problems. Moreover, a detailed plan of data clean-up and migration should be documented (Moller, 2005; Nah et al., 2001).

The vendor or designer of the ERP system takes an explicit and central role in the ERP post-adoption phase to influence the ERP system's behavior. Designers help immensely in forming an overall vision of ERP systems' requirements during the system capabilities selection. Additionally, vendors can customize the ERP system to use industry best practices and/or add enterprise unique capabilities or processes. Moreover, open exchange with the ERP vendor will ensure that the development of the ERP system will take into account the basic requirements of the industry, identify proven recipes for success, and shorten implementation time (Nah et al., 2001; Somers & Nelson, 2001).

Business Process Reengineering (BPR).

BPR proved to be successful in the private sector, allowing Fortune 500 companies to positively institute significant changes within their enterprise, including changes arising from major mergers or acquisition of other businesses (Levin & McCain, 2014). BPR is the process of efficiently aligning software functions and enterprise business processes (Al-Mashari et al., 2003; Kazi, 2015). Figure 2 summarizes the BPR process in a four-step model.

Numerous sources discussed the importance of configuring the business process with the ERP system to minimize customization. Modifications to ERP systems should be avoided to reduce errors and take advantage of newer versions and releases. Additionally, this will positively affect how well managers are able to anticipate and lead the change process. Moreover, several process modeling tools will aid in changing business processes without changing ERP systems. Some organizations incorporated ERP first then focused on process changes afterwards. This piecemeal approach can be beneficial to learning the enterprise processes; however, complications of ERP system modifications may arise and become uncontrollable (Gattiker & Goodhue, 2005; Nah et al., 2001).

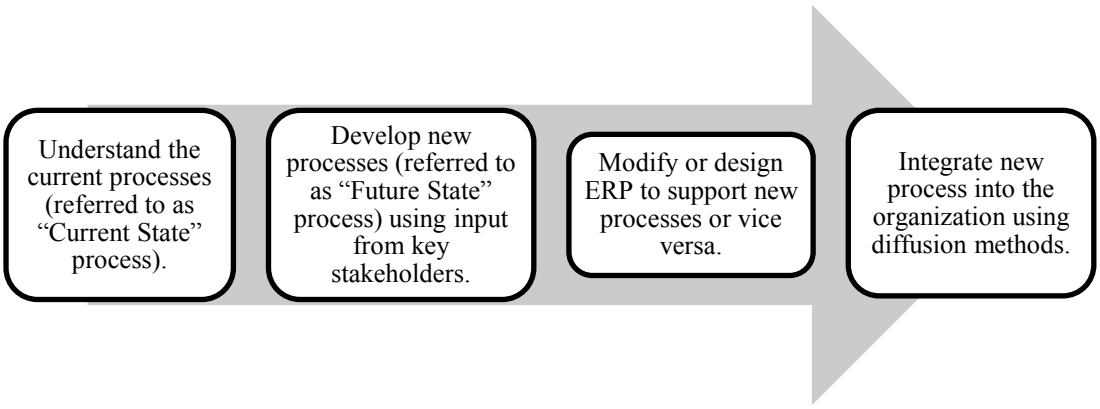

Figure 2: Model for BPR (Kazi, 2015)

Most of the research found during the literature review recommended that BPR should be accomplished during the ERP system development stage. A full comprehension of the feasibility of the necessary Business Process Reengineering at an earlier stage will drastically improve the ERP project outcomes (Sharif, 2005). Leaders and SMEs can determine in advance whether the organization will be capable of aligning its process and ERP system to attain the desired project objectives. It will save the enterprise a significant investment in time and money, if the organization is able to reengineer its processes and ERP system (Kazi, 2015; Nah et al., 2001).

Effective Communication.

Seamless, clear, and effective communication at all levels of an enterprise is a must during any stages of the ERP project (Ngai, Law, & Wat, 2008). Effective communication is a very demanding and difficult task in any ERP project. A detailed Communication Plan (COMMPLAN) may make this task more manageable. Some of the details in the COMMPLAN may include the rationale for the ERP project, process management changes, software testing, change management strategies and tactics, and establishment of critical points of contact (Al-

Mashari et al., 2003). Moreover, an open information strategy has to be maintained for the project to avoid any communication breakdown. Additionally, communication may be in the form of e-mails, presentations, telephones, and/or face-to-face.

Effective communication is critical to user buy-in and involvement. A formal presentation and/or promotion of the project team and top-level managers' public identification of ERP system as a top priority project help achieve user buy-in and involvement. Moreover, employees should be briefed in advance regarding the scope, objectives, activities, updates, and honest admission of future changes. This will help ease tensions among the stakeholders, leaders, managers, and outside organizations (Lau et al., 2016; Nah et al., 2001).

Organizations need to encourage participation and should be open to employee suggestions. Additionally, expectations at all levels need to be communicated. Employees should be informed in advance the scope, objectives, and activities. Most importantly, leaders need to honestly admit that changes will occur (Sarker & Lee, 2003).

Change Management.

Any project commonly involves changes. In an ERP project, responsiveness to users, customers, and stakeholders is critical to avoid complications with the project. An example is the workers' resistance to ERP adoption and implementation. The first step is to distinguish and assess the attitudes of the users and influential groups. This knowledge can be used to develop strategies that can best overpower users' resistance. The next step is to influence the affective or emotional component of users' attitudes such as cost minimization and competitive pressure. These will help eliminate users' uncertainties and acquire strong feelings toward accepting and adopting the new ERP system. Lastly, top management needs to show commitment to the project by getting involved. Management presence, dedication, encouragement, and sponsorship

will assist in securing the needed conditions for successfully introducing and accepting the changes brought by ERP into the enterprise (Aladwani, 2001; Ara & Al-Mudimnigh, 2011).

Technology changes require business and/or process changes. In some cases, this will bring large amounts of changes and may require critical thinking or outside of the box thinking. This will help the enterprise adapt to the new ERP system to achieve performance gains such as increase efficiency, reduce costs, decrease rework, etc. (Nah et al., 2001). Furthermore, leaders may have to take some risks to achieve the ultimate goal.

Management of communication and expectations are essential at every enterprise level (Akkermans & Van Helden, 2002). Employees should be informed as much as possible but should not be overwhelmed. Additionally, training and education are important elements of change management. These allow a better understanding of the overall concept of the ERP system. Moreover, these ensure acceptance and readiness to use the new system. Furthermore, as part of change management, users should be involved during the ERP project (Ngai et al., 2008).

Organizational Readiness for Change Theory

The researcher used the key words "organizational readiness for change theory" using Google Scholar® and found approximately 237,000 references. At the top of the list is the article written by B.J. Weiner titled "A Theory of Organizational Readiness for Change," which was cited 312 times and has an impact factor of 4.12. An impact factor of an academic journal is an evaluation indicating the average number of citations to recent articles published in that journal (Eisenhardt, 1989; Eisenhardt & Graebner, 2007). It is often used as a substitute for the relative importance of a journal within its field, with journals with higher impact factors deemed to be more important than those with lower ones (Eisenhardt & Graebner, 2007).

Weiner (2009) examined the significance of ascertaining organizational readiness for change and recommended various strategies for creating organizational readiness in ERP adoption and incorporation. In his study, Weiner (2009) theoretically defined organizational readiness for change and established a construct of its factors and consequences. The outcome was an organizational level of analyses and a framework that is multilevel and multifaceted, which is called organizational readiness for change (OGRD) theory (Weiner, 2009).

OGRD theory has three facets: change commitment, change efficacy, and computer self-efficacy. These three facets are also called antecedents to organizational readiness for change. Most importantly, these three antecedents are vital to successful ERP adoption and incorporation. Next, the author inquired related articles and found approximately 101 references. Furthermore, author examined the top nine related articles. All 10 articles are shown in Table 2 with their corresponding antecedents. Likewise, these antecedents are briefly explained in this section.

Change Commitment.

Change commitment considers organizational members' common determination to implement a new ERP system in the enterprise's SCM functions. Leaders, managers, employees, SMEs, and stakeholders may value an ERP system for several reasons. Determinants of change commitment are change valence or the degree of attractiveness, perceived usefulness, and perceived ease of use of the ERP system. The reasons why they value the ERP system may be less significant than how much they value the ERP system (Helfrich, Li, Sharp, & Sales, 2009; Holt, Armenakis, Feild, & Harris, 2007).

Table 2: OGRD Theory Literature Review Findings

	ANTECEDENTS		
SOURCES	Change Commitment	Change Efficacy	Computer Self-efficacy
Armenakis, Harris, and Mossholder, 1993		x	
Helfrich, Li, Sharp, and Sales, 2009	x		x
Holt, Armenakis, Feild, and Harris, 2007	x	x	
Holt, Armenakis, Harris, and Feild, 2007		x	
Holt, Helfrich, Hall, and Weiner, 2010	x	x	
Lehman, Greener, and Simpson, 2002		x	x
Rafferty, Jimmieson, and Armenakis, 2013	x	x	
Weiner, 2009	x	x	x
Weiner, Amick, and Lee, 2008		x	x
Weiner, Lewis, and Linnan, 2009	x	x	

Preparing employees will help achieve change commitment during all ERP phases. This includes training employees and managers on how to use the technical aspects of the ERP system, and familiarizing all users with how job responsibilities and processes will change after

ERP incorporation in all of the enterprise's functions and processes (Weiner, 2009). Additionally, preparing the technical aspect of the ERP system, which includes converting the data from the legacy system to the required formats, installing the ERP software as well as simulating and testing the ERP software, shows the importance of the ERP project and will definitely help intensify enterprise members' resolve to implement the change (Holt, Helfrich, Hall, & Weiner, 2010; Weiner, 2009).

Yusuf, Gunasekaran, and Abthorpe (2004) explained the technical challenges faced by Rolls-Royce during ERP implementation. Inaccurate and duplicate data were encountered during the data transfer from their legacy system to the new ERP system, which discouraged the managers and users. As a result, Rolls-Royce decided to take a step back, review their data, and eliminate duplicate data and processes by using BPR (Yusuf et al., 2004).

Change Efficacy.

Change efficacy (CE), in the context of organizational behavior in ERP system incorporation, is also referred to as organizational efficacy (OE) (Armenakis, Harris, & Mossholder, 1993; Holt, Armenakis, Harris, & Feild, 2007; Weiner, 2009). It is the collective or combined extent or strength of enterprise members' belief in their own ability to complete ERP tasks and reach goals. This can be distinguished as the ability to persist and collective ability to succeed with an ERP task. Additionally, this is a human endeavor regarding their collective power to affect any situation. Furthermore, it strongly influences both the collective power to face challenges and the collective choices they are most likely to make. CE can also be referred to as people power (Armenakis et al., 1993; Weiner, 2009).

Change efficacy reflects on organizational members' shared beliefs and acceptance in their individual and collective capability to implement the ERP system. Some important

elements of change efficacy included task knowledge, resource availability, and situational factors. Furthermore, change efficacy is elevated when enterprise members know what to do and how to do it, when they sense they have the resources they need to execute the change to their ERP SCM functions and processes, and when they perceive situational factors such as timing to be promising (Lehman, Greener, & Simpson, 2002; Weiner et al., 2009).

In some organizations, retraining and retooling may be necessary during ERP adoption and incorporation. Retraining and retooling individuals may establish or strengthen enterprise members' belief in their ability to keep up with the enterprise changes. Additionally, retraining and retooling are essential due to changes in enterprise policies, position descriptions, individual responsibilities, and SCM functions and processes. Furthermore, retraining and retooling, at a minimum, should include expected activities, situational complexity, skill performance, situational authenticity, and feedback (Rafferty, Jimmieson, & Armenakis, 2013; Weiner, Amick, & Lee, 2008).

Computer Self-efficacy.

Computer self-efficacy (CSE), also called self-efficacy (SE), is the person's judgment of his or her ability to use an ERP computer system. CSE is affected by the user's perception of the ERP tasks and training received. Prior research suggested that experience, computer anxiety (CA), cognitive engagement, and organizational support were important factors or determinants of CSE. Some of these negative effects can be minimized or eliminated by proper ERP training and appropriate knowledge transfer during ERP system adoption and incorporation (Helfrich et al., 2009).

Knowledge integration, storage, and retrieval immensely help with computer self-efficacy during ERP adoption and post-adoption phases. Individuals generate and learn

knowledge, but they also fail to recall or lose track of the acquired knowledge. Organizational and individual memories are required to store, organize, and retrieve knowledge. In addition, organizational memory is the assembly of individual's memory and is described as the means by which knowledge from the past experience and events shape present organizational activities (Kwahk & Lee, 2008; Weiner, 2009). Furthermore, organizational memory incorporates numerous forms of knowledge from written documents, structured database, and codified knowledge in the form of expert systems, documents of organizational procedures, and processes.

Organizational and individual memories are based on members' observations, experiences, education, and actions. Consequently, knowledge storage refers to unspoken and precise knowledge that could be observed, captured, and documented. Additionally, storing knowledge is essential for use in ERP adoption and post-adoption. This knowledge should include procedures, formal documents, ways of doing things or standard operating procedures (SOPs), inventory information, files, disks, and many other various types of storage (Weiner, 2009; Weiner et al., 2008).

Summary

Chapter 2 presented 11 critical success factors (CSFs) discovered during an extensive literature review relevant to this endeavor. The CSFs are monitoring and evaluating of performance; influential project champion; top management support; clear goals and objectives; user buy-in, involvement, training and education; strategic IT planning; teamwork and team composition; vendor support and performance; business process reengineering; effective communication; and change management. These CSFs are explained in this section. Furthermore, the frameworks used by the article authors were presented and briefly explained.

These frameworks are Process Theory and Organizational Readiness (OGRD) Theory. Additionally, OGRD antecedents were posed. These antecedents are Change Commitment, Change Efficacy (CE) or Organizational Efficacy (OE), and Computer Self-Efficacy (CSE) or Self-Efficacy (SE). Chapter 3 will discuss the methodologies used in this case study.

III. Methodology

Chapter Overview

The general intent of this section is to provide an explanation of the methods and procedures that will be used to accomplish the research objective. Initially, this chapter presents the case study subjects, who are the Maintenance Repair and Overhaul initiative (MROi) project team and stakeholders and Expeditionary Combat Support System (ECSS) Subject Matter Experts (SMEs). Then, the research plan clarifies the reason for using a case study approach. Next, the design stage of the case study explains the unit of analysis and the type of case study selected. Afterwards, the preparation methods of the case study are discussed. Thereafter, the data collection methods used, and the various sources of information reviewed are examined. Lastly, the data analysis and potential sharing or distribution of the case study results will be discussed briefly.

Case Study Subjects and Setting

The MROi project team and support staff are comprised of SMEs from Air Force Materiel Command (AFMC), AFSC, Oklahoma City Air Logistics Complex (OC-ALC), Ogden Air Logistics Complex (OO-ALC), Warner Robins Air Logistics Complex (WR-ALC), and Aerospace Maintenance and Regeneration Group (AMARG). Furthermore, the MROi project management and team leadership are composed of personnel from AFMC/A4NL and AFSC/LG, which are located at Wright Patterson AFB, OH. More specifically, all are contractors and civil service employees.

AFMC/A4NL branch is part of the Systems Integration Division (AFMC/A4N), which is a sub-organization of the Directorate of Logistics, Civil Engineering, and Force Protection

(AFMC/A4). Figure 3 shows this organizational structure. This branch is the principal focal point for enterprise capability initiatives. Additionally, AFMC/A4NL is responsible for assimilating capability initiatives into the global Air Force Log IT transformation strategy. AFMC/A4NL employs structured methodologies to drive business process re-engineering and requirements generation for worldwide mission capabilities. This branch institutes and implements a very comprehensive data strategy and infrastructure.

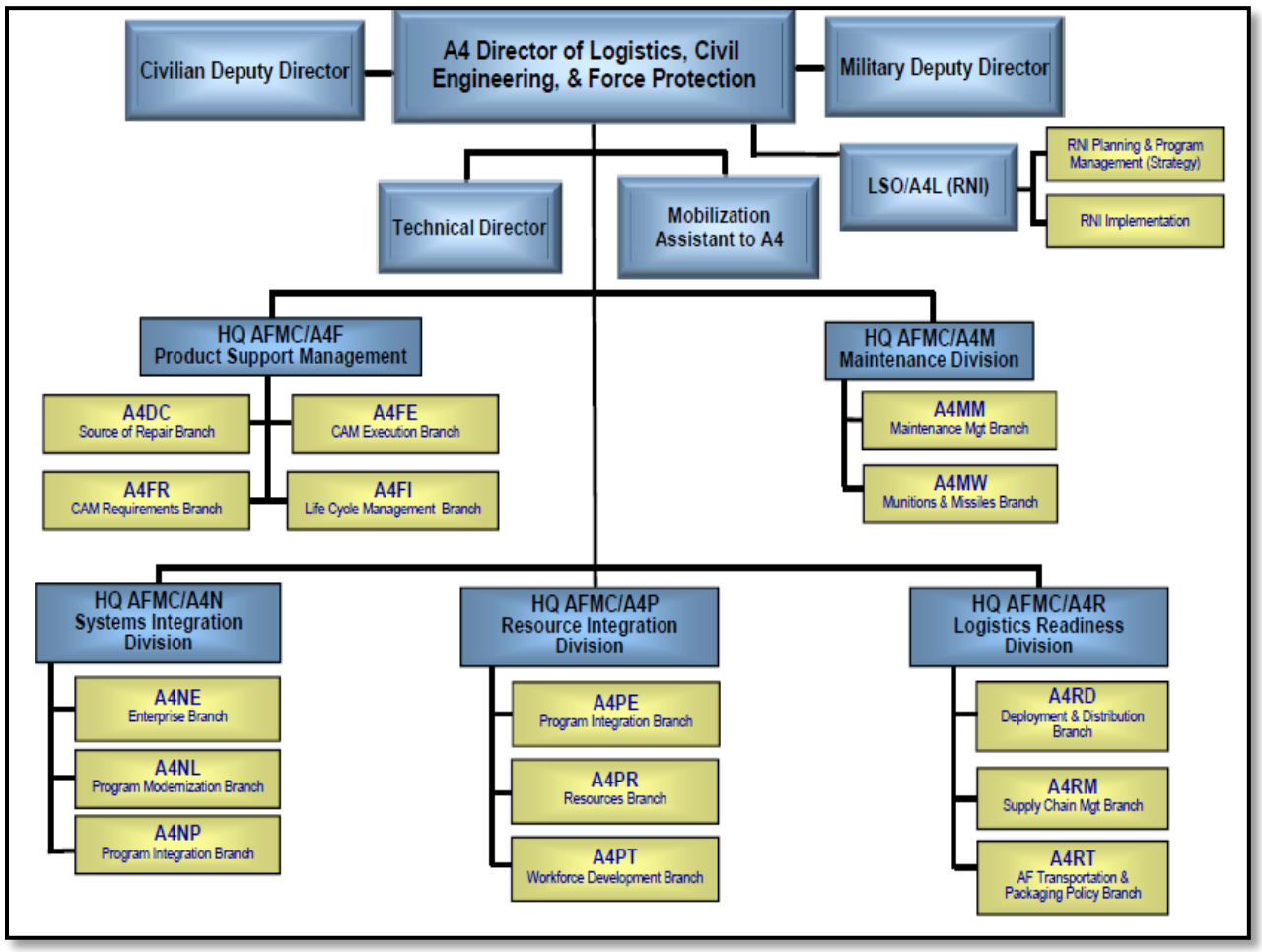

Figure 3: AFMC/A4 Organizational Structure (AFMC/A4DC, 2014)

The AFSC Logistics Directorate (LG) is responsible and accountable for managing the AFSC's global planning, resource, process, and performance implementation to achieve the commander's integrated vision for a strategically-focused enterprise. Furthermore, the AFSC/LG directorate has inherent authority to oversee, integrate, standardize, and direct processes, resources, and organizations to achieve the overall mission. Currently, the directorate is located at Tinker AFB, OK and all three ALCs (OC-ALC, OO-ALC, and WR-ALC) and AMARG report to AFSC/LG (AFSC/LG, 2012). Figure 4 shows the AFSC/LG Directorate organizational structure.

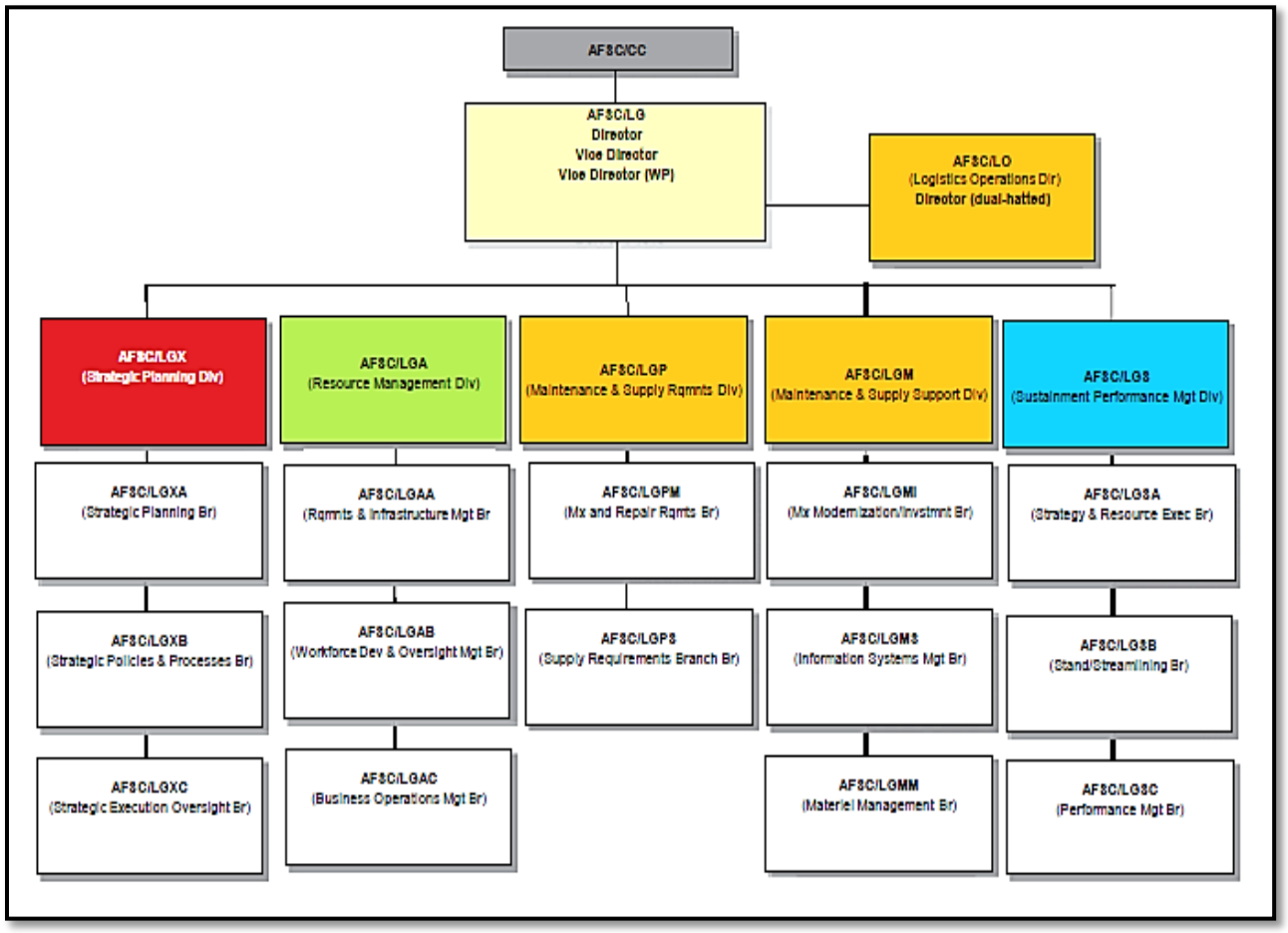

Figure 4: AFSC/LG Organizational Structure (AFSC/LG, 2012)

The ECSS SMEs are composed of current USAF employees and contractors, as well as individuals with Enterprise Resource Planning (ERP) experience who recently retired and remained within the area. These personnel were identified by fellow Air Force Institute of Technology (AFIT) staff, faculty, and students who live in the local area and/or are familiar with the ECSS project. Furthermore, the ECSS Knowledge Transfer Site (KTS) identified individuals and organizations, which are points of contact (POCs) for ECSS questions or concerns.

Plan

The first stages in directing a case study are to pinpoint the problem being investigated and establish if a case study is the appropriate research method. A case study approach is employed to conduct an investigation of a problem into a real-world issue whose boundaries and limitations may not be easily distinguished (Yin, 2014). Additionally, the subject to be investigated may have more variables than quantitative data, and those variables may come from numerous sources (Leedy & Ormrod, 2013). Previously conducted research and extant theory may be used to guide data collection and analyses in a case study (Leedy & Ormrod, 2013; Yin, 2014). For the problem discussed in Chapter 1, theories do exist and research is available to address the underlying problem but not clearly understood. Furthermore, ERP adoption and post-adoption in the military or federal government are poorly comprehended and have been largely unsuccessful (Leedy & Ormrod, 2013). As a result, this research was conducted using a case study approach.

Numerous qualitative research methods were considered, but the case study was the most appropriate methodology to answer the research questions. Ethnography method was not appropriate, because the research was not addressing a complete cultural issue in which we had to observe a person, program, or event in their/its natural setting (Leedy & Ormrod, 2013).

Additionally, the phenomenological study was not the best option because the research problem did not call for an investigation into people's perceptions, perspectives and views, or social realities. The grounded theory research was not appropriate, because the data collected and interpreted in this study will not be used to derive a theory but rather make managerial inferences based on the findings (Yin, 2014). Lastly, content analysis method alone was unsuitable for this study, because the research does not require identification of patterns – only an analysis of the ERP projects (ECSS and MROi) compared to the recommended practices found in the literature review (Leedy & Ormrod, 2013). However, content analysis was used in the literature review section to identify common derivatives or patterns (CSFs and antecedents) in existing studies, which help address the research and investigative questions of the case study.

The case study approach is the most appropriate research methodology for the problem being investigated, because the problem addresses how the organizational and managerial processes of ERP adoption and post-adoption can be improved (Yin, 2014). The case study approach is the optimal approach, but there are limitations. The biggest limitation is that a case study has the possibility of being subjective (Leedy & Ormrod, 2013). As a result, the data collected in a case study can be interpreted in numerous ways and may lead to inadequate analyses and deficient conclusions.

Another limitation of a case study is that the quality of the data relies on the knowledge and skills of the researcher. Therefore, if a researcher has weak interviewing skills, the data collected from his/her interviews will be incomplete or may contain deficient information. Additionally, a case study may have errors of memory and judgment. Finally, a case study has no fixed limits of investigation, and the researcher is dependent on the current situation (Eisenhardt, 1989; Eisenhardt & Graebner, 2007).

Design

The design phase of a case study requires defining the study's unit of analysis (Leedy & Ormrod, 2013; Yin, 2014). In this case study, the ECSS and MROi ERP systems are the units of analyses. In order to address the underlying problem, the core for the research must be the implementation plans of the ECSS and MROi ERP systems. Furthermore, the research will address the risks and lessons learned from both ERP systems. Most importantly, other strategic and organizational issues involved in effectively managing ERP system adoption and post-adoption in the military or federal government will be analyzed. The case study question began as "How are the MROi leadership, planners, and subject matter experts applying lessons learned from ECSS to eliminate or mitigate risks for potential cost increase and schedule overruns that may lead to MROi failure?"

Another aspect of the design stage is selecting the type of case study that will be conducted. A multiple case study design was selected for this research due to the procedures that will be used to evaluate the identified phenomenon, and the two different ERP initiatives will be compared (Yin, 2014). The literature review discovered antecedents, theories, and CSFs used in ERP initiatives through content analysis of 38 academic sources or articles. This method may be used to develop a conceptual framework linking successful ERP system antecedents and CSFs. Furthermore, the use of this analysis is an acceptable foundation for a multiple case study (Eisenhardt, 1989; Eisenhardt & Graebner, 2007; Leedy & Ormrod, 2013; Yin, 2014).

Prepare

Once the case study approach is determined and the research and investigative questions are classified, the next stage is the preparation to conduct the case study (Leedy & Ormrod, 2013). The case study data collection method included interviews; therefore, it was imperative

to acquire approval for human subjects testing. Additionally, it was imperative to develop case study protocol and ascertain data collection procedures.

Human subjects interview requirements.

This case study included interviews with numerous stakeholders in the ECSS and MROi ERP projects. The researcher learned the basic human subject research training designed by the Collaborative Institutional Training Initiative (CITI) using the Air Force Institute of Technology (AFIT) facilities, network, and computer systems. More specifically, this training includes history and ethics of human subjects research, ethical testing concepts, informed consent, privacy and confidentiality, vulnerable subjects, conflicts of interest, and more (Leedy & Ormrod, 2013).

This research is eligible for an exemption from human experimentation requirements, because the methods in place protect any personally identifiable information (PII) that may have negative impacts on the subjects. The approved exemption memorandum is provided in Appendix 1. This measure is in place to safeguard the interview subjects from any undesirable consequences for the unclassified information he/she may contribute to the research. All PII will not be included in this thesis. Furthermore, the interview documents will be kept separate and available only to the researcher. Additionally, the interview subjects will be asked to sign a consent form, which specifies the interview procedures and risks. The consent form is provided in Appendix 2. Most importantly, the interviewees will be given a generic name (e.g. ECSS SME 1, ECSS SME 2, MROi SME 1, etc.) in this research.

Interview methods.

In the preparation stage, it is essential to identify the data collection procedures. A semi-structured interview was performed in this study. The interview subjects were determined based on their role in the ERP systems adoption and post-adoption (Kvale, 2007). More specifically,

key stakeholders were identified using the ECSS KTS, AFSC/LGP members' SharePoint group records, AFIT staff, faculty, and students familiar with ECSS program at WPAFB, OH. Additional stakeholders were identified in meetings and discussions with the MROi leadership team members. Stakeholders outside of the MROi leadership team include SMEs from OC-ALC, OO-ALC, WR-ALC, and AMARG. Interview subjects located with the research team at WPAFB, OH were desired because of limited time, travel availability, and limited funding. Most importantly, they could meet in-person. If the interview subjects were not located at WPAFB, the interview was conducted via telephone or electronic mail (e-mail).

Access to interview subjects.

The first approach to identifying interview subjects was by asking AFIT staff, faculty, and students familiar with the local ECSS program office. Furthermore, interviews were solicited based on professional relationships with AFIT faculty. The second approach was to identify stakeholders from the ECSS KTS database and AFSC/LG SharePoint records and solicit their participation via e-mail and phone calls. In addition, interviewees were limited to approximately 20 personnel to avoid data over saturation (Guest, Bunce, & Johnson, 2006). Each of the interview subjects was provided the consent form and a project summary sheet to give them more details regarding the research being conducted. The project summary sheet is provided in Appendix 3.

Interview questions.

The next step in the preparation phase was creating a set of questions to guide the discussion during interviews. Additionally, these questions were used as a basis for the discussions, and follow-on questions were asked based on the interviewee's reply. The questions slightly vary based on the stakeholder or ERP system but were comparable for each of the

interviews. Interview subjects were informed that the objectives of the interview or discussion were to understand the adoption and post-adoption situations of each ERP system. Sample interview questions can be found in Appendix 4, MROi Sample Interview Questions, and Appendix 5, ECSS Sample Interview Questions (Guest et al., 2006).

Data evaluation.

The material gathered from the interviewees was used primarily to gain new information, which can be verified by other sources. This is significant in establishing reliability and validity of the data collection method. Furthermore, information gathered should be verified by more than one source, in order to reach a dependable conclusion.

Resources.

The MROi team at AFSC/LG provided the researcher with resources necessary to conduct the case study. Some of the important resources provided were an open discussion of the research study; a monthly meeting with the MROi team in building 70, Area A, WPAFB, OH; and a weekly telephone conference (telecon) with stakeholders from AFMC, three ALCs, and AMARG. Additionally, the researcher was given access to the ECSS KT and AFSC/LG SharePoint websites. Furthermore, the MROi team provided weekly telecon notes to the researcher.

Collect

Numerous sources were used to collect data for the case study. All data gathered will be recorded in a case study database, and multiple records will be used to verify findings. Furthermore, the sources will include working archival records and documents, interviews, direct observation, and participant observations.

Archival Records and Documents.

The first archival record that will be used is the ECSS KTS website, also called the ECSS Program Smart Shutdown, which was built by the Air Force Life Cycle Management Center (AFLCMC) in 2012. Additionally, ECSS KTS includes the identification, classification, and compilation of ECSS official files and other useful artifacts with SMEs unique perspective of what happened and why. Furthermore, the ECSS KTS website was designed to share lessons learned for future DoD or USAF projects to avoid project failure (AFLCMC/HII, 2012). Another source that was used was the AFSC/LG SharePoint website, which was built by AFSC/LG staff in 2012. The AFSC/LG SharePoint website is one of the main tools to share information with all the authorized division members. Furthermore, other documents such as memoranda, e-mail correspondence, individual information, meeting minutes, reports, internal records, presentations, and contract documents were collected from various stakeholders and other open sources available through public and private databases.

Interviews.

Approximately 20 semi-structured interviews will be conducted to collect information from various ERP stakeholders. These stakeholders included ECSS POCs, AFMC, AFSC/LG, three ALCs, and AMARG. Furthermore, the data collected from the interviews will be stored in a case study data base and analyzed in Chapter 4. Most importantly, PII will be removed to protect interviewees from any negative impacts, which may result from the information he or she provided for the case study.

Direct Observation.

The researcher was involved in the weekly telephone conference with AFMC, AFSC/LG, three ALCs, and AMARG during the period of October 2015 to January 2016. Furthermore, the

researcher met with the MROi team once a month or anytime to verify concerns or answer questions. In addition, the researcher gathered information through formal and informal discussions, prepared for and conducted interviews, and conducted research on various USAF information systems. Most importantly, the researcher has extensive depot maintenance background and does not provide any inputs to avoid influencing the process.

Participant Observations.

The researcher achieved access to the ECSS KTS database, AFSC/LG SharePoint and cMRO (Complex Maintenance, Repair and Overhaul) tool, which is Oracle's MRO solution, and became an active user. Additionally, the researcher learned to conduct searches, navigate information, and understand its processes with the help and training of MROi team members. Most importantly, the researcher has extensive AFMC depot maintenance experience of over 15 years. cMRO is a complete end-to-end maintenance solution to manage, integrate, and optimize lean MRO operations across aerospace, defense, commercial, and heavy industries (Dorsey, 2014). Some of the cMRO benefits are:

1. Standardize, repeatable, and measurable processes
2. Enterprise visibility of workload capability and capacity
3. Better accountability of parts and material
4. Tracks actual touch time for mechanics
5. Auditable, accountable – Financial Improvement Audit Readiness compliant
6. Provides single system for workers and management to do their jobs
7. Single system transactions ensure increased data fidelity
8. Legacy system reduction (approximately 11 legacy and 12 site-specific systems)

Analysis

A more detailed analysis of all the data collected from the sources identified above will be included in Chapter 4. Furthermore, the analysis will rely on theoretical propositions found in the literature review to establish a pattern among the data collected. The main advantage of using multiple sources of data collection is to verify and validate the information and material used in the case study analysis and findings.

Share

Once the case study was completed, the information was presented to the AFIT community in a thesis and defense presentation. The MROi team may be presented with this information, because they are a very important audience for this case study. The evidence found in this case study may be of assistance to leaders, managers, and supervisors facing similar ERP issues discussed in this research. This information may be available in future journal publications.

Summary

This section presented an explanation of the methods and procedures that were used to accomplish the research objective. More specifically, this chapter provided the case study subjects, reasons for using a case study approach, design stage, preparation methods, data collection methods, sources of information reviewed, data analysis, and potential sharing or distribution of the case study results. Chapter 4 will present and discuss the analysis and results of this case study.

IV: Analysis and Results

Chapter Overview

The purpose of this chapter was to answer the overall research question by answering the investigative questions (IQs) 1, 2, 3, and 4, which were presented in Chapter 1. The researcher found 11 critical success factors (CSFs) useful in successful ERP adoption and implementation during the literature review. The identification of 11 CSFs answers IQ 1, which asked for critical elements or factors of a successful ERP adoption and implementation.

The core for the research must be the implementation plans for both ERP systems as mentioned in Chapter 2. However, an ECSS implementation plan never existed. Therefore, the researcher will address the risks and lessons learned from both ERP systems.

Reliability and validity of the data and information gathered were verified by using more than one source. Furthermore, part of the participant observation was the researcher's extensive depot maintenance experience of more than 15 years. Chapter 3 research methodologies were employed for answers to IQs 2, 3, and 4. Answers were presented as follows:

1. For IQ 2 – ECSS root causes and contributing factors
2. For IQs 3 and 4 – MROi findings

Collected Archival Records and Documents

The ECSS Knowledge Transfer Site (KTS) was comprised of over 500,000 extensive archival records and documents. Additionally, AFSC/LG SharePoint site contained over 1,000 lengthy archival records and documents. Therefore, the researcher enlisted assistance from AFMC, AFSC/LG, AFLCMC/HII, and ECSS subject matter experts (SMEs), and MROi SMEs in navigating through the sites and understanding the details of reports, spreadsheets, charts,

drawings and other applicable documents. As a result, 28 relevant archival records and documents were identified and listed in Table 3. Additionally, the researcher used other documents such as memoranda, e-mail correspondence, meeting minutes, reports, internal records, presentations, and contract documents collected from various stakeholders and open sources available through Google Scholar® and EBSCO Host®.

Table 3: List of Archival Records and Documents Reviewed

Name of Archival Records and Documents
1 - ECSS Contract Change Proposal 10-0035 Attachment 24, Integrated Master Plan (IMP) Revision D
2 - Service Development and Delivery Process (SDDP) Step One Deliverable Package for MROi, Version 2.3
3 - SDPP Step Two Deliverables Package for MROi, Version 3.0
4 - SDPP Step Three Deliverable Service Reference Model (SRM) for MROi, Version 2.0
5 - SDPP Step Three Material Implementation Plan for MROi, Version 2.0
6 - SDPP Step Three Deliverable Data Reference Model (DRM) for MROi, Version 4.0
7 - MROi Overview Presentation for AFMC/EN, May 2015
8 - MROi Step Two Product Approval Brief, June 2013
9 - MROi Final DOTMLPF Implementation Plan Presentation, June 2013
10 – MROi BPR Compliance Brief, Aug 2012
11 - Appendix B: MROi Plan Points to Problem Statement/Capability Mapping
12 - Appendix D: MROi DOTMLPF Implementation Plan, June 2013
13 - Appendix E: MROi Performance Measures
14 - Appendix F: MROi Business Process Re-engineering (BPR) Assessment

Name of Archival Records and Documents
15 - MROi SME Telecon Meeting Notes, Oct 2015 - Jan 2016
16 – MROi Business Case (Problem Statement), Version 2.0
17 – ECSS Knowledge Domain Summary (KDS) for The Lessons Learned Process
18 – Observations from Rapid Assessment of Select AF Major Automated Information System Programs
19 – ECSS KDS for Top Lessons Learned from Pilots A/B/C
20 – ECSS KDS for Risk Management
21 – ECSS KDS for CSC Joint Active Risk Matrix
22 – ECSS KDS for External Audit Risks
23 – Air Force Implementation Baseline, Version 2.1
24 – ECSS Program Management Office Lessons Learned (L2) Process
25 – DoD Business Systems Modernization: Navy ERP Adherence to Best Business Practices Critical to Avoid Past Failures (GAO-05-858)
26 – ECSS KDS for Fielding
27 – ECSS KDS for Big Rocks and Decisional Issues
28 – ECSS KDS for Application Architecture

Interviews Performed

Researcher interviewed 18 SMEs or stakeholders from December 2015 through January 2016. Stakeholders, interview dates, and interview methods were listed in Table 4. Stakeholders were composed of ECSS SMEs, MROi team leaders, and MROi team support staff. Interviewees gave approval to use their answers if needed. The researcher also gave

interviewees copies of the IRB package. Additionally, the AFMC MROi team was relocating and merging with the AFSC MROi team during the interview process, which created a slight delay in data collection and interviews. This resulted in impromptu interviews of MROi team leadership and support staff.

Table 4: List of Stakeholder Interviews

Stakeholder	Date	Interview Method
1 - ECSS SME 1	9 Dec 2015	E-mail
2 - ECSS SME 2	10 Dec 2015	Telephone
3 - ECSS SME 3	11 Dec 2015	E-mail
4 - ECSS SME 4	7 Jan 2016	In-person
5 - ECSS SME 5	12 Jan 2016	Telephone
6 - ECSS SME 6	13 Jan 2016	Telephone
7 – MROi SME 1	14 Dec 2015	In-person
8 - MROi SME 2	15 Dec 2015	In-person
9 - MROi SME 3	17 Dec 2015	In-person
10 - MROi SME 4	6 Jan 2016	Telephone
11 - MROi SME 5	6 Jan 2016	Telephone
12 - MROi SME 6	5 Jan 2016	In-person
13 – MROi SME 7	5 Jan 2016	In-person
14 - MROi SME 8	8 Jan 2016	In-person
15 - MROi SME 9	8 Jan 2016	In-person
16 - MROi SME 10	12 Jan 2016	Telephone
17 - MROi SME 11	13 Jan 2016	In-person
18 - MROi SME 12	15 Jan 2016	Telephone

IQ 1: What are the critical elements of a successful ERP adoption and implementation?

Eleven Critical Success Factors (CSFs) were presented and discussed in Chapter 2. The CSFs were monitoring and evaluation of performance; influential project champion; top management support; clear goals and objectives; user buy-in, involvement, training and education; strategic IT planning; teamwork and team composition; vendor support and performance; business process reengineering; effective communication; and change management. These CSFs are necessary for a successful ERP project.

The frameworks used by the journal article authors were presented and briefly explained in Chapter 2. These frameworks were Process Theory and Organizational Readiness (OGRD) Theory. Additionally, OGRD antecedents were posed. These antecedents were change commitment, change efficacy (CE), and computer self-efficacy (CSE).

IQ 2: What Root Causes, Critical Factors, Elements, and/or Issues contributed to the failure of ECSS?

Root Causes.

A root cause is an existence of an action or inaction which, by itself, would lead to program failure. Furthermore, a root cause is an initiating effect of either a condition or a causal chain that leads to an outcome. Moreover, a root cause is a harmful element that may be fundamental to the program (Krishnamurthy, Husebo, & Stewart, 2013; Levin & McCain, 2014).

ECSS Root Cause 1: Unsuccessful Data Management.

ECSS SME 6 (2016) and Krishnamurthy et al. (2013) stated that the ECSS team did not know the location of all the data and architectures in which they reside. Additionally, the USAF does not have visibility of all the data personnel rely on to perform their day-to-day

responsibilities. Full visibility of all the data available should be the first step to understanding what needs to be replaced. Furthermore, master data needs to be identified and understood (ECSS SME 6, 2016; Krishnamurthy et al., 2013).

According to AFLCMC/HII (2012) and ECSS SME2 (2015), duplicate data exists in the USAF. For example, flying hours were recorded in several aircraft forms (e.g. AF Form 781A, AF Form 781B, etc.). This data is transferred into the Core Automated Maintenance System for Mobility and the Integrated Maintenance Data System Central Database. Then, these flying hours were transmitted to the Reliability and Maintainability Information System. This goes into the Peacetime Programming Computational System monthly, where the data may undergo changes due to reconciliation or late reporting.

Flying hours from the AF Form 781 were also recorded in the Automated Records Management System for tracking aircrew currency. Of all these systems, ECSS Program Office (PO) did not know which system contained the master data. Additionally, AF/A3 managed the flying hour program, but AF/A4 is dependent upon the flying hours for scheduled and unscheduled maintenance, but there is no governance to deal with this cross functionality (AFLCMC/HII, 2012; ECSS SME 2, 2015).

As stated by ECSS SME 1 (2015), ECSS SME 3 (2015), and ECSS SME 6 (2016), overlapping data were allowed to exist. One ALC captured data one way and another ALC did it differently. This was compounded by the fact that each system captures different amounts and types of data. Therefore, there will always be stakeholders with a reason to keep the old system running (ECSS SME 1, 2015; ECSS SME 3, 2015; ECSS SME 6, 2016).

According to ECSS SME 1 (2015), ECSS SME 3 (2015), and ECSS SME 6 (2016), legacy systems existed in the USAF that support the same process and/or policy, but there was

no integration or interoperability between these systems (ECSS SME 1, 2015; ECSS SME 3, 2015; ECSS SME 6, 2016). An example is the AFMC 202, Request for Engineering Support, systems in all three ALCs. Multiple 202 systems existed that did not communicate with each other. Additionally, maintainers were mandated to have access to the different 202 systems for their organization's supported weapon systems. This created confusion and non-interoperability situations across the ALCs and Aircraft Maintenance and Regeneration Group (AMARG).

ECSS SME 4 (2016) and Mikusa and Pierce (2012) identified that legacy system edits and validations were insufficient to prevent entry of wrong and/or incorrect data. Therefore, the amount of dirty data was unknown. This was very difficult to identify and hard to correct. Additionally, business rules needed to be defined and implemented. Most importantly, users should be held accountable for compliance (AFLCMC/HII, 2012; ECSS SME 4, 2016; Mikusa & Pierce, 2012).

ECSS Root Cause 2: Not Fully Understanding the Current State or the Future State Architecture.

According to Krishnamurthy et al. (2013), there was no true understanding of the current state architecture among the users. The current state architecture was confusing and poorly communicated (Krishnamurthy et al., 2013). SMEs from all three ALCs and AMARG were required to identify the current state architecture for ECSS for each of their processes. This was very difficult because the ALCs were using different systems to support the same process and/or policy (AFLCMC/HII, 2012). This lack of detailed knowledge of the current state architecture resulted in an incomplete evaluation of the future state architecture represented in ECSS (AFLCMC/HII, 2012; Krishnamurthy et al., 2013).

AFLCMC/HII (2012), ECSS SME 5 (2016) and Krishnamurthy et al. (2013) stated that the number of legacy systems ECSS was to replace was unknown. The unidentified number of home-grown or legacy systems was never reported to AFMC/A4, because it was not required. Furthermore, the estimated number of legacy systems that ECSS was supposed to replace varied between 100 to 900 systems (AFLCMC/HII, 2012; Krishnamurthy et al., 2013).

The unknown number of legacy systems created unknown unknowns when it came to data. This situation contributed to the overall misunderstanding of the existing data. In addition, "everything" was never defined anywhere in any ECSS document. Therefore, ECSS was not able to take the necessary steps to move forward. ECSS SMEs felt they took three steps forward and then six steps backwards (AFLCMC/HII, 2012; ECSS SME 5, 2016).

ECSS Root Cause 3: Deficient Transition Plan from Current State to the Future State.

AFLCMC/HII (2012) and ECSS SME 1 (2015) explained that ECSS lacked a transition plan from the present state to the future state. Traditionally, in the acquisition system, the first task is to develop requirements to satisfy a new capability or a new need and will never look backwards. For example, the F-16 was designed in the early 1970s with three primary requirements of fly-by-wire technology, low-risk full scale development and production, and future upgrade options. The F-16 acquisition team was not required to look at an old aircraft that was being replaced. They were always looking forward. ECSS acquisition team concentrated on the future state and did not look back at systems being replaced, what data to retain, and what data to discard (AFLCMC/HII, 2012; ECSS SME 1, 2015). The outcomes were not understanding the current state, current data, and unidentified crucial program requirements.

AFLCMC/HII (2012) and ECSS SME 5 (2016) identified multiple ongoing legacy systems that have limbs reaching into numerous organizations. These multiple interdependent

and possibly interrelated ongoing legacy systems were being replaced by ECSS. Therefore, it was imperative that SMEs and stakeholders for these legacy systems must know the current state of their systems, relationships of their systems with other systems, and the future state of their systems when merged or replaced by ECSS. The transition plan was absent. Furthermore, there was additional confusion because most ECSS SMEs thought that the project itself was the transition plan. Therefore, no implementation plan existed for ECSS (AFLCMC/HII, 2012; ECSS SME 5, 2016).

ECSS Root Cause 4: Lack of an Executable Plan.

According to ECSS SME 3 (2015) and Krishnamurthy et al. (2013), the USAF lacked a way to properly execute the transition of current architecture to future architecture. ECSS was supposed to obtain a software package that could accomplish the future state, but knew that no single stand-alone product would meet this requirement based on market research. Therefore, software bolt on or added applications were permitted to meet this requirement and resulted in multiple interfaces. A detailed execution plan to deal with these multiple interfaces never existed (ECSS SME 3, 2015; Krishnamurthy et al., 2013).

AFLCMC/HII (2012) and ECSS SME 2 (2015) indicated that SMEs were required to work with the system integrators to code the vision of ECSS through the blue printing process of the future state of ECSS. All of the SMEs had different processes they utilized, and these same individuals were asked to communicate a single vision to the system integrator on how the transition should occur. This created oppositions, questions, and more concerns during the ECSS project (AFLCMC/HII, 2012; ECSS SME 2, 2015).

ECSS Root Cause 5: Lack of the Right Culture and Development Environment.

AFLCMC/HII (2012) and Krishnamurthy et al. (2013) specified that everyone did not understand the vision of ECSS. Therefore, ECSS was not fully accepted. Personnel were never assured their interests were cared for in this program (Gibson, Ivancevich, Donnelly, Jr., & Konopaske, 2012). ECSS tried to develop a system in an unrealistic environment that did not mirror the operational environment reality. Interviewees did not fully understand the reason for this. Furthermore, there were personnel issues in ECSS. The Air Staff created a direct reporting office collocated with the ECSS PO. Basically, the USAF created watchers watching the watchers, which created tensions between the two offices (AFLCMC/HII, 2012; Krishnamurthy et al., 2013).

According to AFLCMC/HII (2012), ECSS SME 1 (2015), ECSS SME 5 (2016), and ECSS SME 6 (2016), positions were staffed with term positions not permanent positions. Unintentionally, a logistics temporary agency was created and the turnover was high. In addition, significant advisory and assistance services were brought in. The Air Staff hired acquisition experts and the ECSS PO contracted logistics experts, but both bought ERP expertise. Most importantly, ECSS had six program managers in eight years and five program executive officers in six years. This high turnover rate and constant chaotic changes created an unsteady environment, which is not conducive to a successful project outcome (AFLCMC/HII, 2012; ECSS SME 1, 2015; ECSS SME 5, 2016; ECSS SME 6, 2016).

Contributing Factors.

Contributing factors, elements and/or issues may lead to a disruption of cost, schedule, or performance but did not singularly lead to program failure or cancellation. Furthermore, these factors or elements, if taken individually, were unlikely to cause program failure. Contributing

factors may be any behavior, omission, or deficiency that may set the stage for a delay or program failure (Krishnamurthy et al., 2013; Levin & McCain, 2014).

ECSS Contributing Factor 1: Governance Issues.

Conflicting policies and procedures existed. Krishnamurthy et al. (2013) and United States Government Accountability Office (GAO) (2005) stated that elements of the Department of Defense Instruction (DoDI) 5000.2, Business Capability Lifecycle (BCL), and Service Development and Delivery Process (SDDP) methodologies were used simultaneously as compliance and process tools. Clear direction, guidance, and coordination from process owners on how to mesh and apply these intermixed methodologies were non-existent and most of the time deficient or conflicted. Therefore, delays, frustrations, uncertainties, and burdens were created for the ECSS PO (Krishnamurthy et al., 2013; United States GAO, 2005).

BCL was designed to streamline business processes for business system acquisitions. BCL methodologies were applied in 2007 for the ECSS project, which was before BCL approval in 2008. This practice created constant change and chaos within the ECSS team. SDDP procedures were introduced in 2009, and the ECSS team found itself complying with various elements of all three policies. Using draft BCL methodologies, SDDP, and DoDI 500.2 created redundancy, confusion and disorder throughout the project (AFLCMC/HII, 2012; Krishnamurthy et al., 2013; United States Government Accountability Office, 2005).

ECSS Contributing Factor 2: Ineffective Procedures.

AFLCMC/ESC (2012) and United States GAO (2005) identified that the ECSS team did not understand the large number of legacy systems and amount of data. This lack of understanding led to a Request for Quote that did not successfully communicate the true needs of the USAF. Additionally, the ECSS PO was not prepared to deal with the unreported or

undocumented legacy systems and the data they contained. These were the critical unknown unknowns of the ECSS program (AFLCMC/ESC, 2012; United States GAO, 2005).

According to ECSS SME 1 (2015) and ECSS SME 4 (2016), ECSS was expected to use COTS software. However, the project started generating significant amounts of reports, interfaces, conversions, and extensions instead of changing processes and policies to accommodate the COTS software. Also, Oracle product software integration problems drove program delays and negatively affected the system integrator's delivery performance (ECSS SME 1, 2015; ECSS SME 4, 2016).

754th Electronic Systems Group (ESG) (2010), ECSS SME 1 (2015) and ECSS SME 4 (2016) stated that requirements were added late in the ECSS project. Product Lifecycle Management (PLM) and Logistics Financials (LogFins) were added requirements to the ECSS project in 2009. PLM tracks the long-term system engineering of the logistics systems. LogFins constitute the tracking of the unique Working Capital Funds financials used in the supply chain management of all USAF weapon systems. These added requirements further delayed the schedule (754th ESG, 2010; ECSS SME 1, 2015; ECSS SME 4, 2016).

Business process reengineering (BPR) was mandated by several legislative and internal DoD directives, such as the U.S. Deputy Chief Management Officer, Interim Guidance for the Implementation of Section 1072 of the FY 2010 National Defense Authorization Act – Business Process Reengineering. However, needed process changes using BPR guidelines were not executed. BPR efforts were designed to ensure successful and seamless transition from old methods to new, which was a more efficient way to do business. This failure led to numerous and costly efforts to customize the software to support the ECSS project (AFLCMC/HII, 2012; ECSS SME 2, 2015; ECSS SME 5, 2016).

ECSS Contributing Factor 3: Lack of Effective Change Management and Stability.

AFLCMC/HII (2012), ECSS SME 3 (2015), and Krishnamurthy et al. (2013) stated that the maintenance community was fearful of how ECSS would impact their positions or jobs, because it was never explained to them how ECSS will help them with their day-to-day responsibilities. Additionally, an unknown number of legacy systems that were independently developed existed and supported different processes. Users were at ease using these homegrown legacy systems and relied on them to perform their duties. Therefore, ECSS was understood and signified as a large scale disrupting technology that negatively affected users' daily operations, hence, the resistance to change. Most importantly, full buy-in from the maintenance community was never achieved (AFLCMC/HII, 2012; ECSS SME 3, 2015; Krishnamurthy et al., 2013).

AFLCMC/HII (2012), ECSS SME 6 (2016), and Krishnamurthy et al. (2013) stated that ECSS experienced six program manager changes in eight years, five program executive officers changes in six years, and several organizational structure changes, all of which were supported by most staff serving term positions. This significant turnover rate of senior leaders during the ECSS project and poor organizational structure contributed to substantial vagueness and cultural instability. Additionally, some of these practices served as a major distraction over the ECSS project. Most importantly, these events intensified the difficulty of moving forward and precluded the rise and success of the ECSS project (AFLCMC/HII, 2012; ECSS SME 6, 2016; Krishnamurthy et al., 2013).

AFLCMC/HII (2012), ECSS SME 3 (2015), and ECSS SME 4 (2016) identified that the lack of a high-level executive and continuous change of program management personnel contributed to the instability and lack of effective leadership in the ECSS program. This absenteeism led to untimely and questionable key acquisition decisions during critical points in

the program. Additionally, the new personnel with less familiarity and historical knowledge were left to make decisions for which they were not ready. This lack of effective leadership generated needless delays, communication gaps, and loss of institutional knowledge and familiarity (AFLCMC/HII, 2012; ECSS SME 3, 2015; ECSS SME 4, 2016).

IQ 3 and IQ 4: Has the MROi team encountered the same Root Causes, Critical Elements, and/or Issues? How did the MROi mitigate these risks?

According to AFMC/A4N and AFSC/LGP (2013), MROi SME 1 (2015), and MROi SME 2 (2015), MROi inherited some of the conditions identified from ECSS' root causes and contributing factors. MROi is a means to salvage, correct, and continue the work started during the ECSS project. MROi is AFSC's first attempt at an enterprise resource planning solution. Additionally, it is AFSC's way to recover from the failure of ECSS to standardize working practices and procedures across the ALC's and AMARG (AFMC/A4N and AFSC/LGP, 2013; MROi SME 1, 2015; MROi SME 2, 2015).

The MROi project is delayed because of Acquisition Category (ACAT) determination, system implementation (SI) source selection, and USAF network architecture evaluation for almost two years according to MROi SME 1 (2015) and MROi SME 3 (2015). ACATs are determined to enable decentralized decision-making, execution, and other compliance requirements imposed by the U.S. government. In early 2014, MROi was an ACAT III effort with a Research, Development, Test, and Engineering (RDT&E) price tag of $139M in early 2014 (MROi SME 1, 2015; MROi SME 3, 2015). According to Hogan (2012), an ACAT III program is an acquisition program that does not meet the criteria of an ACAT II, which is defined as a program estimated to require RDT&E expenditure of more than $140M (Hogan, 2012).

In 2015, during MROi system implementation source selection, the price increased to over $370M of RDT&E including all planned increments (Increments 1, 2, and 3). Due to this price increase, the program moved from an ACAT III to an ACAT I (MROi SME 1, 2015; MROi SME 3, 2015). ACAT I programs are Major Automated Information System (MAIS) that are estimated to exceed $365M of all expenditures such as increments and RDT&E incurred from the beginning until deployment at all locations (Hogan, 2012). This change resulted in more delays for the MROi program, because the Milestone Decision Authority (MDA) changed from AFSC/CC to the Under Secretary of Defense for Acquisition, Technology, and Logistics (AFSC/LG, 2012; Hogan, 2012; MROi SME 1, 2015; MROi SME 3, 2015).

MROi findings presented below are based on archival documents and records reviewed by the researcher. Furthermore, 12 MROi SME interviews were collected using IRB procedures and protocol. Moreover, the researcher verified interviewees' answers, if needed.

MROi Finding 1: Transition Plan and Execution Plan.

AFMC/A4N and AFSC/LGP (2013) identified that the functional sponsor made a cautious and methodical endeavor to include commercial off-the-shelf configurations in the future state architecture in the Service Development and Delivery Process (SDDP) Step Three Deliverable Material Implementation Plan document. This should aid in a seamless transition of the current state to future state. However, it was unclear if this would deliver the most beneficial functions in an orderly fashion. Furthermore, there were interdependencies among the increments because of the existence of prerequisites, which may have caused schedule delays and increased costs (AFMC/A4N and AFSC/LGP, 2013).

AFSC/LGP and HQ AFMC/A4NE (2013), Bury (2013), and HQ AFMC/A4NE and AFSC/LGP (2013) stated that part of the execution plan is having a return on investment (ROI)

estimate. The total MROi cost is estimated at over $300M with a return on investment (ROI) of 2.17 years after implementation. This may assist establishing productivity objectives for vendors, MROi Program Management Office (PMO), and Financial Management Office (FMO). Furthermore, this will drastically aid in creating performance measures for the MROi team (AFSC/LGP and HQ AFMC/A4NE, 2013; Bury, 2013; HQ AFMC/A4NE and AFSC/LGP, 2013). However, the fielding strategy, shown in Figure 5, is delayed because of the ACAT III to ACAT IA change, which can destructively affect the ROI (AFSC/LGP and HQ AFMC/A4NE, 2013; MROi SME 2, 2015; MROi SME 3, 2015).

MROi Finding 2: Development Environment and Understanding the Current State and Future State.

According to AFMC/A4N and AFSC/LG (2013), MROi SME 4 (2016), MROi SME 7 (2016), MROi SME 9 (2016), and MROi SME 12 (2016), a problem statement existed that explains the future state of MROi. Additionally, according to AFSC/LGP (2012) and Lyman (2012), MROi BPR assessment identified disparate business processes. More specifically, all three depot maintenance facilities have a total of 30 process variants supported by 50 customized stove-piped legacy systems. Moreover, excessive numbers of manual processes were highly dependent on archaic methods of communication (AFMC/A4N and AFSC/LGP, 2013; AFSC/LGP, 2012; Lyman, 2012; MROi SME 4, 2016; MROi SME 7, 2016; MROi SME 9, 2016; MROi SME 12, 2016).

MROi SME 6 and MROi SME 10 stated that the potential benefits of MROi such as production turnaround time, increased weapon systems availability, and lower maintenance costs were not fully explained. Furthermore, according to MROi SME 11, MROi was highly dependent on legacy systems retirement. This aspect of MROi is vulnerable to cost growth and

delays. Moreover, some legacy system shut downs will be gradual and may be costly at the end (MROi SME 6, 2016; MROi SME 10, 2016; MROi SME 11, 2016).

According to AFSC/LGP (2012), Bury (2013), and Crane and Bury (2013), significant uncertainties existed because of interface assumptions, which is not unexpected at this phase of the effort. However, these uncertainties should be fully resolved before any funds are committed. These interface assumptions may negatively affect the project development phase and overall costs of the initiative if left unsolved (AFSC/LGP, 2012; Bury, 2013; Crane & Bury, 2013).

AFSC/LG (2012), MROi SME 1 (2015), MROi SME 2 (2015), and MROi SME 3(2015) identified that awaiting ACAT determination, SI source selection, and determination of current USAF network architecture are major obstacles for the MROi project. All of these challenges were outside of the MROi team's control. Therefore, the team was forced to wait while keeping all stakeholders engaged. One of the ways to keep key personnel at AFMC, AFSC, ALCs and AMARG informed, involved, and excited about the MROi project was to distribute a monthly MROi Newsletter, shown in Figure 6 (AFSC/LG, 2012; MROi SME 1, 2015; MROi SME 2, 2015; MROi SME 3, 2015).

MROi Finding 3: Understanding the Data and Right Culture.

HQ AFMC/EN (2015), MROi SME 5 (2016), MROi SME 8 (2016), MROi SME 11 (2016), and MROi SME 12 (2016) specified that master data for legacy systems have been identified and quantified. This will assist extensively with solving the data problem inherited from ECSS (HQ AFMC/EN, 2015; MROi SME 5, 2016; MROi SME 8, 2016; MROi SME 11, 2016; MROi SME 12, 2016). One of the goals of the MROI project was to improve data quality

and consistency across all three ALCs and AMARG, which was met with the detection and classification of the master data.

According to AFSC/LG (2012) and HQ AFMC/EN (2015), legacy systems will be shut down by increments as shown in Figure 5, which is also called the MROi fielding strategy. The fielding strategy showed all the known legacy systems from all the three ALCs and AMARG. Commodities and Aircraft were the two main categories with two increments, Increment 1 and Increment 2. Black out meant a complete shutdown of all the legacy systems. Brown out meant a very gradual shut down (black out) of a system because of unknown interfaces. Brown out will be very critical in this fielding strategy because of the shared systems use of the commodities and aircraft organizations. Currently, the MROi program is on hold because of the pending ACAT determination, SI source selection, and network architecture analysis (AFSC/LG, 2012; HQ AFMC/EN, 2015).

According to MROi SME 5 (2016), MROi SME 8 (2016), MROi SME 9 (2016), and MROi SME 10 (2016), governance confusion still exists. MROi leadership and staff are burdened with numerous metrics to measure progress, completions, and other performance measures to meet DoDI 5000.2, SDDP, BCL, and DOTMLPF policies. It appears that no coordinated attempt has been made by leadership to provide unified and consistent guidance on how to merge and harmonize these policies and processes that is clear, consistent, and easily executable. This adds to the ambiguity of the MROi project (MROi SME 5, 2016; MROi SME 8, 2016; MROi SME 9, 2016; MROi SME 10, 2016; MROi SME 11, 2016; MROi SME 12, 2016).

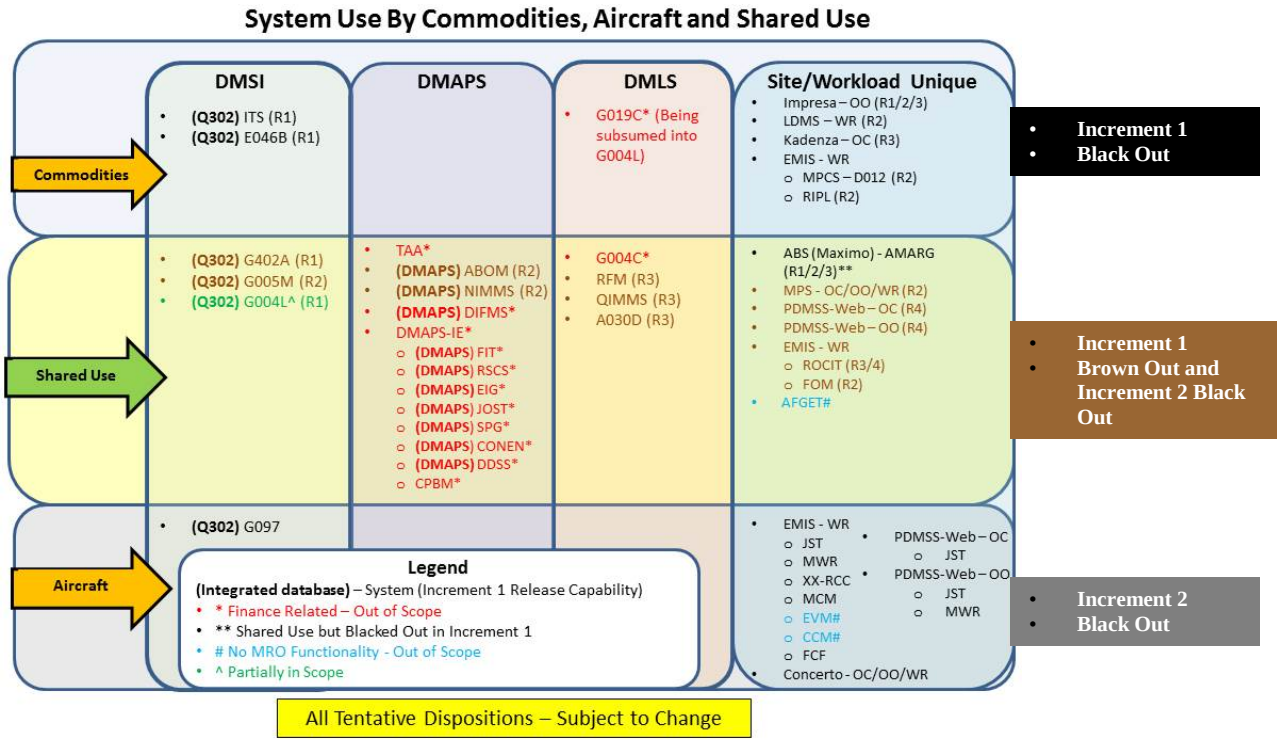

Figure 5: MROi Fielding Strategy (AFSC/LG, 2012; HQ AFMC/EN, 2015)

Summary

This chapter answered IQs 1, 2, 3, and 4. Researcher found 11 critical success factors (CSFs) used in successful ERP adoption and implementation. Furthermore, researcher discovered five ECSS root causes, three ECSS contributing factors, and three MROi findings.

ECSS root causes presented in this section were unsuccessful data management, not fully understanding the current state or the future state architectures, deficient transition plan from current state to the future state, lack of an executable plan, and lack of the right culture and development environment. Additionally, ECSS contributing factors were governance issues, ineffective procedures, and lack of efficient change management and stability. MROi findings were transition plan and execution plan, development environment and understanding the current

state and future state, and understanding the data and right culture. Chapter 5 will present conclusions and recommendations.

Figure 6: MROi Newsletter (AFSC/LG, 2012)

V. Conclusion and Recommendations

Chapter Overview

The purpose of this chapter is to summarize the findings and show the correlation of critical success factors, ECSS root causes, ECSS contributing factors, and MROi findings. Additionally, this section will address the significance or impact of the findings and their implications. Furthermore, recommendations for action are presented in this chapter. Finally, paths for future or follow-on research efforts and the conclusion will be presented.

Research Findings

Table 5 shows the correlation of critical success factors (CSFs), ECSS root causes (RC), ECSS contributing factors (CF), and MROi findings. ECSS RCs and ECSS CFs identified jointly in Chapter 4 were separated, as shown in the first left column of Table 5. As an example, ECSS CF 3, lack of effective change management and stability, were shown separately as change management and stability in Table 5.

Green or yes means that an attempt was taken by a member of the MROi team (leadership, planners, and SMEs) to affect or change the lessons learned from ECSS RC or ECSS CF. Red or no means that no attempt was taken by any member of the MROi team to affect or change the lessons learned from ECSS RC or ECSS CF. Yellow or unknown means that actions taken by the MROi team were affected by one of the delays (ACAT determination, system implementation source selection, and network analysis). Additionally, yellow may turn green at any point during the MROi project.

ECSS RCs and ECSS CFs that may influence any critical success factor (CSF) were marked with an "X" under the affected CSF. For example, ECSS RC data management was

given an "X" because it may influence two CSFs (strategic IT planning and vendor support and performance). Additionally, if MROi team was given a green or yes, then green "X's" were given under the influenced CSFs.

Currently, governance issues existed according to MROi SME 5 (2016), MROi SME 8 (2016), MROi SME 9 (2016), and MROi SME 10 (2016). No records or data of any action taken or any attempt to harmonize DoDi 5000.2, BCL, and SDDP occurred. Therefore, governance was identified as red in Table 5 (MROi SME 5, 2016; MROi SME 8, 2016; MROi SME 9, 2016; MROi SME 10, 2016).

Table 5: CSFs, ECSS RCs, ECSS CFs, and MROi Findings

		Critical Success Factors (CSFs)										
ECSS ROOT CAUSES AND CONTRIBUTING FACTORS	MROi	Monitoring and Evaluation of Performance	Influential Project Champion	Top Management Support	Clear Goals and Objectives	User Buy-in, Involvement, Training, and Education	Strategic IT Planning	Teamwork and Team Composition	Vendor Support and Performance	Business Process Reengineering	Effective Communication	Change Management
Data Management	YES						X		X			
Current State Architecture	UNK				X		X	X	X	X	X	
Future State Architecture	UNK				X		X	X	X	X	X	
Transition plan from Current state to Future state	YES				X			X	X		X	
Executable Plan	YES	X			X			X			X	
Right Culture	UNK					X		X			X	X
Development Environment	YES					X		X				X
Governance	NO		X	X				X				
Effective Procedures	YES				X	X	X					
Change Management	YES					X		X			X	X
Stability	YES					X		X			X	X

HQ AFMC/EN (2015), MROi SME 5 (2016), MROi SME 8 (2016), MROi SME 11 (2016), and MROi SME 12 (2016) disclosed that master data for legacy systems were identified and quantified. Furthermore, data purging is currently underway (HQ AFMC/EN, 2015; MROi SME 5, 2016; MROi SME 8, 2016; MROi SME 11, 2016; MROi SME 12, 2016). Therefore, data management was given two greens under strategic IT planning and vendor support and performance.

According to AFMC/A4N and AFSC/LG (2013), MROi SME 4 (2016), MROi SME 7 (2016), MROi SME 9 (2016), and MROi SME 12 (2016), the current state architecture and future state architecture were ascertained but were postponed because of the system implementation (SI) source selection, ACAT determination, and network analysis delays. Therefore, yellows were given under the MROi column for current state architecture and future state architecture. Furthermore, current state architecture and future state architecture may affect the following critical success factors (CSFs): clear goals and objectives; strategic IT planning; teamwork and team composition; vendor support and performance; business process reengineering; and effective communication. Subsequently, all CSFs were given yellow (AFMC/A4N and AFSC/LGP, 2013; MROi SME 4, 2016; MROi SME 7, 2016; MROi SME 9, 2016; MROi SME 12, 2016).

As stated by AFMC/A4N and AFSC/LGP (2013) and Bury (2013), the use of commercial off-the-shelf (COTS) program for MROi was settled as part of the transition plan from current state to future state. Therefore, the MROi column was given a green. Furthermore, the following CSFs: teamwork and team composition; vendor support and performance; and effective communication, may be affected by the transition plan from current state to future state.

Consequently, the identified CSFs were given all greens (AFMC/A4N and AFSC/LGP, 2013; Bury, 2013).

The MROi team has an executable plan with an estimated return on investment of 2.17 years and an estimated total cost of over $300M according to AFSC/LGP and HQ AFMC/A4NE (2013), Bury (2013), and HQ AFMC/A4NE and AFSC/LGP (2013). Therefore, the MROi column was given a green. Additionally, the executable plan may affect three critical success factors. They are clear goals and objectives, teamwork and team composition, and effective communication. Accordingly, they were given all greens (AFSC/LGP and HQ AFMC/A4NE, 2013; Bury, 2013; HQ AFMC/A4NE and AFSC/LGP, 2013).

AFSC/LG (2012) and HQ AFMC/EN (2015) identified that the incremental approach for legacy shut down was planned by the MROi team. However, this approach was delayed because of system implementation source selection. Thus, the right culture was given a yellow under MROi column. Additionally, the right culture may affect the user buy-in, involvement, training, and education; teamwork and team composition of all the SMEs and stakeholder at the ALCs and AMARG; effective communication; and change management. Consequently, all the identified CSFs were given yellows (AFSC/LG, 2012; HQ AFMC/EN, 2015).

The MROi fielding strategy increments were planned for the commodities organizations, aircraft production organizations, and a cautious shutdown of shared-use legacy systems in between for all the ALCs and AMARG's operational environment according to Bury (2013), MROi SME 2 (2015), and MROi SME 3 (2015). Furthermore, this slow and steady methodology attained buy-in from all the stakeholders and SMEs. Therefore, the development environment was given a green under MROi column (Bury, 2013; MROi SME 2, 2015; MROi SME 3, 2015).

According to MROi SME 5 (2016), MROi SME 8 (2016), MROi SME 9 (2016), and MROi SME 10 (2016), governance confusion existed. MROi team is burdened with numerous metrics to measure progress, completions, and other performance measures to meet DoDI 5000.2, SDDP, BCL, and DOTMLPF policies. Researcher discovered no coordinated attempt has been made by the MROi team to request a unified and consistent guidance (MROi SME 5, 2016; MROi SME 8, 2016; MROi SME 9, 2016; MROi SME 10, 2016). Hence, governance was given a red on the MROi column. Governance may affect the influential project champion, top management support, and teamwork and team composition CSFs. Thus, these identified CSFs were given reds.

AFSC/LGP (2012) and Lyman (2012) indicated that MROi team's business process reengineering assessment identified disparate business processes. More specifically, all three depot maintenance facilities have a total of 30 process variants supported by 50 customized stove-piped legacy systems. Therefore, a green was given under MROi column for effective procedures. Moreover, CSFs affected by effective procedures (clear goals and objectives; user buy-in, involvement, training, and education; and strategic IT planning) were given greens (AFSC/LG, 2012; Lyman, 2012).

AFSC/LG (2012), MROi SME 1 (2015), MROi SME 2 (2015), and MROi SME 3(2015) identified that delays cannot be controlled by the MROi team. However, the MROi team tried to keep the momentum of the project by distributing a monthly MROi Newsletter and monthly meetings with all SMEs and stakeholders from ALCs and AMARG (AFSC/LGP, 2012; MROi SME 1, 2015; MROi SME 2, 2015; MROi SME 3, 2015). Therefore, a green was given to change management under the MROi column. Additionally, all possible affected CSFs were given greens.

MROi SME 1 (2015), MROi SME 6 (2016), MROi SME 10 (2016), and MROi SME 12 (2016) stated that stability was minimized by reorganization of AFSC/LG. More than 70% of the MROi team was composed of permanent civil service employees. Most importantly, MROi leadership was comprised of non-provisional employees (MROi SME 1, 2015; MROi SME 6, 2016; MROi SME 10, 2016; MROi SME 12, 2016). Hence, the stability was given a green under the MROi column. Likewise, all CSFs (user buy-in, involvement, training, and education; teamwork and team composition; effective communication; and change management) possibly affected by stability were given all greens.

Significance of Findings

The USAF attempts to recover, right, and restart the work that ECSS ", big bang," started through the progress of MROi, "small bang." MROi inherited some of the problems encountered during the ECSS project, but on a smaller scale. MROi is delayed because of ACAT change determination, SI source selection, and analyses of network architecture. Additionally, these delays are coupled with governance issues. All of these conditions may escalate the risks for uncontrollable cost increases and schedule overruns for the program, which may ultimately lead to project failure (AFMC/A4N and AFSC/LGP, 2013; MROi SME 1, 2015; MROi SME 2, 2015).

Weiner (2009) discussed that organizational readiness for change varies as a function of value of change or valence and informational assessment or value of information. Additionally, Holt et al. (2010) and Weiner (2009) posited that when organizational readiness for change is elevated, then there is a greater chance that enterprise members will initiate change, exert effort, exhibit persistence, and be more cooperative. Moreover, Holt et al. (2010), Weiner et al. (2008), and Weiner et al. (2009) discussed that circumstantial conditions affect organizational readiness

for change. These contextual factors are organizational culture, governance or policies and procedures, past experience, organizational resources, and organizational structure (Holt et al., 2010; Weiner, 2009; Weiner et al., 2008; Weiner et al., 2009). These are depicted in Figure 7, Factors of Organizational Readiness for Change.

Holt et al. (2010) and Weiner et al. (2009) stated the three limitations to the measurement of the contextual factors. First is the subjectivity of the measurement. Enterprise members may miscalculate organizational readiness by overestimating or underestimating these factors. Second is the time dependency. Measurements of these factors can rapidly change in a short period of time. Third is that organizational readiness does not assure a successful implementation of a multifaceted organizational change in terms of enhancing quality, safety, efficiency or some other anticipated results (Holt et al., 2010; Weiner et al., 2009).

According to AFLCMC/HII (2012) and Krishnamurthy et al. (2013), ECSS lacked the proper organizational culture because the vision of ECSS was not completely explained. Thus, ECSS was not fully accepted. Furthermore, ECSS lacked effective organizational structure stability as stated by AFLCMC/HII (2012), ECSS SME 3 (2015), and Krishnamurthy et al. (2013). Changes in program managers and program executive officers, and the hiring of temporary personnel contributed to instability, delays, communication gaps, and loss of institutional knowledge and familiarity. These factors contributed to the failure of ECSS (AFLCMC/HII, 2012; ECSS SME 3, 2015; Krishnamurthy, et al., 2013).

MROi inherited the governance condition from ECSS as indicated by AFMC/A4N and AFSC/LGP (2013), MROi SME1 (2015), and MROi SME 2 (2015). Additionally, MROi SME 5 (2016), MROi SME 8 (2016), MROi SME 9 (2016), and MROi SME 10 (2016) affirmed that governance confusion existed. As stated by Holt et al. (2009), Weiner (2009), Weiner et al.

(2008), and Weiner et al. (2009), governance is a circumstantial factor to attain organizational readiness for change. Therefore, there is a probability that organizational readiness for change may not be fully attained during the MROi project, which may result in cost increases and schedule overruns that may ultimately result in program failure (Holtet al., 2007; Weiner, 2009; Weiner et al., 2008; Weiner et al., 2009).

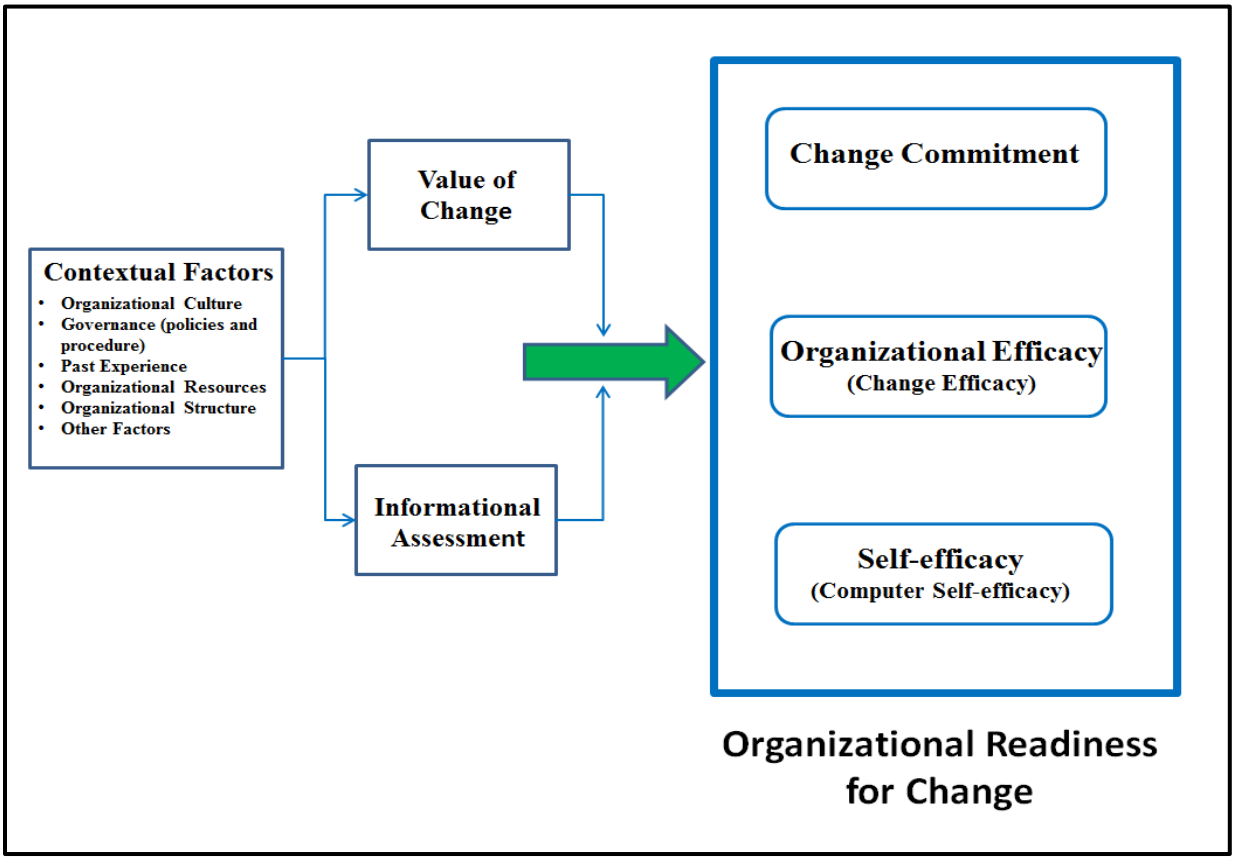

Figure 7: Factors of Organizational Readiness for Change (Holt et al., 2009; Weiner, 2009; Weiner et al., 2008; and Weiner et al., 2009)

According to MROi SME 1 (2015), MROi SME 5 (2016), and MROi SME 10 (2016), the USAF attempted to leverage the experiences gained in ECSS through the development of MROi.

However, MROi leadership, planners, and SMEs do not have control over the delays (ACAT determination, SI source selection, and analyses of USAF network architecture). Therefore, the team was forced to wait while keeping all stakeholders engaged by distributing a monthly MROi Newsletter and weekly telephone conferences with SMEs from all ALCs and AMARG. Furthermore, governance ambiguity slows the decision-making cycle, steals valuable time away from the actual program execution, creates the appearance of indecisiveness, and negatively affects the conviction of the team (MROi SME 1, 2015; MROi SME 5, 2016; MROi SME 10, 2016).

Implications of Findings

ECSS was not a total failure according to AFLCMC/HII (2012) and ECSS SME 1 (2015). ECSS was the first step to truthfully recognizing and discovering the enormous task of transforming the USAF into a more capable organization. It appears that no coordinated effort or attempt has been made to provide unified and consistent guidance on how to merge and harmonize policies and processes (e.g. DoDI 5000.2, SDDP, BCL, and DOTMLPF) that are clear, consistent, and easily executable. This adds to the ambiguity and may increase overall costs of the MROi program (AFLCMC/HII, 2012; ECSS SME 1, 2015).

MROi was AFSC's first attempt at an enterprise resource planning (ERP) solution, as stated by AFMC/A4N and AFSC/LGP (2013), MROi SME 1 (2015), and MROi SME 2 (2015). MROi master maintenance data contains information from other organizations such as finance, contracting, and other logistics. Functional organizations responsible for these data are considered external stakeholders and should be included in MROi's business process reengineering (AFMC/A4N and AFSC/LGP, 2013; MROi SME 1, 2015; MROi SME 2, 2015).

An ERP strategic planning is desired. ERP strategic planning may cover at least the following: execution strategy, transition plan, current state map, future state scheme, and feasibility studies. This may help eliminate possible multiple ERP solutions fielded in the USAF. Furthermore, this may reduce manpower and cost (Jacobs & Chase, 2014).

Recommendations for Action

This approach, from a "big bang" to a "small bang," may face challenges over the long term. One recommendation is to have a feasibility study, which may help identify gaps, obstacles, and project difficulties. Additionally, feasibility studies may help our leaders recognize conflicting policies and provide unified and consistent guidance to project team leadership and members. This guidance may assist with the execution of strategic policies to meet project requirements and needs of the USAF (Jacobs & Chase, 2014).

The USAF may want to cautiously wean herself away from using homegrown legacy systems. Functional Commands may need to handle, control, and account for all of the legacy systems. This may help locate and control all data. Furthermore, policies and processes should be improved by using business process reengineering (BPR). Eliminate non-value added steps and change policies, if needed. This may help reduce overhead and/or indirect costs in some organizations.

According to Boudreau and Robey (1999), civilian industry can force compliance, because they are either successful and become more profitable or they go broke and go out of business. The USAF does not have the same motivation. The USAF's mission is to fly, fight, and win. Therefore, USAF enterprise members are obligated to accomplish the mission. Consequently, if an ERP system does not support mission accomplishment, then enterprise members find a way by using another ERP system or legacy system (Boudreau & Robey, 1999).

According to AFLCMC/HII (2012), ECSS SME 1 (2015), and ECSS SME 2 (2015), there is no requirement to comply from the chain of command to use an ERP system, because the USAF does not have a comprehensive understanding of what needs to be replaced. Therefore, the USAF needs an all-inclusive awareness of the end goal for a global ERP solution before mandatory ERP system compliance. An ERP strategic plan may assist with expanding the enterprise knowledge and understanding of the necessity of a global ERP solution (AFLCMC/HII, 2012; Boudreau & Robey, 1999; ECSS SME 1, 2015; ECSS SME 2, 2015; Jacobs & Chase, 2014).

Recommendations for Future Research

This research study may be recreated. Critical success factors (CSF) identified during the literature review may be used as possible elements or answers to the interview questions. Caution of leading the interviewees to the answers or CSFs may be required. This may be achieved by carefully restructuring the interview questions.

Ram, Corkindale, and Wu (2015) stated that extant studies and theories on successful ERP incorporation are extensively focused on elements such as financial, material, and informational resources for private industries and none for the military. Furthermore, studies on the relationship of antecedents of organizational change and CSFs in successful ERP implementation are non-existent. Therefore, a quantitative study of the relationship between antecedents and CSFs is an important future study (Ram, Corkindale, & Wu, 2015).

Kumar et al. (2002) identified that in spite of the growing maturity of ERP systems, technological developments, increased availability of a skilled workforce, and knowledgeable consultants or vendors, the military and/or federal government encountered an ERP innovation misfortune. Furthermore, government organizations are faced with unique social obligations,

greater legislative liability, and public accountability. Most importantly, government ERP may be slightly different from the commercial world. Therefore, the need for a proven framework that combines CSFs, antecedents, organizational readiness for change theory, and process theory that can be practically applied by the military and/or federal government could be of great importance. Furthermore, understanding the relationship between antecedents and CSFs during ERP innovation adoption and post-adoption may help the enterprise prepare or tailor their efforts to successfully attend to proper CSFs at the right phase of the ERP project (Kumar et al., 2002).

A gap analysis between successful and unsuccessful ERP systems should be performed. Data from successful ERPs may help understand changes that should be enforced in the government. Some of these changes may be changes to the acquisition policy (e.g. DoDI 5000.2), contracting instructions, maintenance procedures, and other guidelines. Furthermore, leaders may need to accept that some DoD policies or procedures may not be amendable because of the nature of DoD's business. Therefore, a flexible ERP system that can accommodate minimal customization should be considered.

MROi SME 1 (2015) and MROi SME 3 (2015) identified that the MROi project is delayed due to ACAT determination, system implementation (SI) source selection, and USAF network analyses. Therefore, data collection and quantitative studies after MROi implementation are possible future research topics. Data may reflect MROi actual cost, return on investment, and other useful information that may be used for future ERP projects (MROi SME 1, 2015; MROi SME 3, 2015).

Holt et al. (2010), Weiner (2009), Weiner et al. (2008), and Weiner et al. (2009) discussed that the complexity of ERP adoption and implementation, coupled with organizations' resistance to change, has led researchers to recognize large numbers of critical success factors

(CSF). Current studies and assumptions seem to be that managers, who take the CSF-based method to ERP projects, will be able to use information about the CSFs to plan, mitigate risks, proactively monitor progress, and take necessary actions to influence and guide the project outcome. However, this may not be effective in a government organization. Therefore, future studies should find a way to classify CSFs based on organizational size, type of industry, organizational culture, and other external factors (Holt et al., 2010; Weiner, 2009; Weiner et al., 2008; Weiner et al., 2009).

A possible future research topic is the use of emerging ERP technology. Cloud-based enterprise resource planning (CBERP) systems are available and may be used in manufacturing according to Xu (2012). Additionally, CBERP systems may be modified to fit current policies and processes; therefore, the need for BPR may be delayed or eliminated. Moreover, security algorithms may be added at a local or central location. CBERP can also handle massive amounts of data. For example, Google®, who is currently processing 20 petrabytes, which is equivalent to 20,000 terabytes, of memory per day, uses CBERP (Rimal, Choi, & Lumb, 2009; Xu, 2011; Zhang & Zhou, 2009).

Conclusion

In today's technological environment, organizations rely on effective ERP systems to be globally competitive. The USAF failed in 2003. However, the USAF enterprise is faced with unique policies, procedures, social obligations, greater legislative accountability, and public liability. As a result, the USAF has not been able to leverage available IT capabilities at an enterprise level. This report addressed the challenges, root causes, and contributing factors during the ECSS project. Furthermore, this study identified how the USAF attempts to recover,

right, and restart the work that ECSS started through the development of the MROi project, which is faced with delays and possible uncontrollable cost increases.

According to Boudreau and Roby (1999), ERP transition should be incremental, a "small bang" approach, instead of radical, a "big bang" approach. An incremental approach would help vendors, consultants, and users learn during ERP system development. ECSS was a "big bang" approach because it was revolutionary for the USAF. ECSS was a completely new configuration of doing business that was considered radical, which ultimately did not gain full enterprise acceptance (Boudreau & Robey, 1999).

MROi appears to be an incremental method, a "small bang" approach. Additionally, MROi identified three core missions: planning, scheduling, and executing. Currently, MROi is overwhelmed with delays and seems to be losing momentum. However, the MROi team attempts to keep stakeholders engaged and interested (Boudreau & Robey, 1999).

This research study identified critical success factors (CSF), theories, and antecedents for a successful implementation of an ERP that may help the USAF's ERP situation. These CSFs, theories, and antecedents may help minimize the negative impacts of the enterprise-level ERP deficiencies. Additionally, these CSFs, theories, and antecedents may be used to improve the IT effectiveness of any organization challenged with enterprise-level IT deficiencies until those deficiencies are resolved.

Appendix 1: Approved Exemption Memorandum

DEPARTMENT OF THE AIR FORCE
AIR FORCE INSTITUTE OF TECHNOLOGY
WRIGHT-PATTERSON AIR FORCE BASE OHIO

1 December 2015

MEMORANDUM FOR LT COL MATTHEW DOUGLAS

FROM: William A. Cunningham, Ph.D.
AFIT IRB Research Reviewer
2950 Hobson Way
Wright-Patterson AFB, OH 45433-7765

SUBJECT: Approval for exemption request from human experimentation requirements (32 CFR 219, DoDD 3216.2 and AFI 40-402) for your study concerning which ECSS lessons learned are applied by MROi leadership and subject matter experts (SMEs) to eliminate or mitigate risks for potential project failure.

1. Your request was based on the Code of Federal Regulations, title 32, part 219, section 101, paragraph (b) (2) Research activities that involve the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior unless: (i) Information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) Any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

2. Your study qualifies for this exemption because you are not collecting sensitive data, which could reasonably damage the subjects' financial standing, employability, or reputation. Further, the demographic data you are utilizing and the way that you plan to report it cannot realistically be expected to map a given response to a specific subject.

3. This determination pertains only to the Federal, Department of Defense, and Air Force regulations that govern the use of human subjects in research. Further, if a subject's future response reasonably places them at risk of criminal or civil liability or is damaging to their financial standing, employability, or reputation, you are required to file an adverse event report with this office immediately.

WILLIAM A CUNNINGHAM, PH.D.
AFIT Exempt Determination Official

Appendix 2: Consent Form

CONSENT TO PARTICIPATE IN INTERVIEW

MROi RESEARCH

You have been asked to participate in a research study conducted by researchers from the Air Force Institute of Technology (AFIT), Graduate School of Engineering and Management, Department of Operational Sciences. The main objective of the project is to assist the MROi project team at Air Force Sustainment Center Logistics Directorate (AFSC/LG) in determining how well the MROi project is doing. The results of this study will be included in a briefing to the AFMC and AFSC staff, as well as research publications. You were selected as a possible participant in this study because of your knowledge of the MROi or ECSS. You should read the information below and ask questions about anything you do not understand before deciding whether or not to participate.

- This interview is voluntary. You have the right not to answer any question, and to stop the interview at any time or for any reason. I expect that the interview will take 30-45 minutes.
- You will not be compensated for this interview.
- The information you provide will be kept confidential. All data will be presented at an aggregate level.
- I would like to record this interview so that I can transcribe it and use it for analysis as part of this study. I will not record this interview without your permission. If you grant permission for this conversation to be recorded, you have the right to revoke permission and/or end the interview at any time.
- This project will be completed by April 2016. All interview documents will be stored in a secure work space until 1 year after that date. The documents will then be destroyed.

I understand the procedures described above. My questions have been answered to my satisfaction, and I agree to participate in this study. I have been given a copy of this form.

(Please initial)

[ ] I give permission for this interview to be recorded and transcribed.

Name of Subject:

Signature of Subject _____ Date _____

Signature of Investigator _____ Date_____

Please contact me with any questions or concerns at george.lafiguera@afit.edu.

Mr. Lafiguera/AFIT/ENS/DSN875-3636x4740/gbl/12Nov2015

Appendix 3: Project Summary Sheet

TALKING PAPER ON

MAINTENANCE, REPAIR, AND OVERHAUL INITIATIVE (MROi) AND

EXPEDITIONARY COMBAT SUPPORT SYSTEM (ECSS) RESEARCH PROJECT

- The purpose of this talking paper is to introduce a research study being conducted by the Air Force Institute of Technology (AFIT) to assist the MROi project team at Air Force Sustainment Center Logistics Directorate (AFSC/LG) in determining how well the MROi project is doing. The purpose of the study is to identify the extent to which ECSS lessons learned are applied by MROi leadership and subject matter experts (SMEs) to eliminate or mitigate risks for potential project failure.

- Issue / Research Problem Statement

  -- In early 2012, the ECSS program was cancelled mainly due to uncontrollable increases in cost and schedule overruns. In late 2012, AFSC launched MROi to improve or increase enterprise visibility and efficiency, as well as filling some of the gaps deferred by ECSS. Furthermore, MROi is a concentrated Enterprise Resource Planning (ERP) system compared to ECSS and a more focused grouping of logistics systems and processes.

  -- Decision makers at AFSC need to know how well the MROi project is doing in helping AFSC organizations achieve established objectives.

- Research Objectives

  -- Identify the extent the MROi project team is identifying and mitigating risks.

  -- Identify how well ECSS lessons learned are applied by MROi decision makers, stakeholders, and SMEs to identify and mitigate potential risks that may result in increased costs and schedule overruns ultimately leading to program failure.

- Research Methodology

  -- Multiple-case study of ECSS and MROi ERP systems.

- Points of Contact

  -- Mr. George B. Lafiguera, Student, AFIT, Department of Operational Sciences

  -- Lt Col Matthew Douglas, Assistant Professor, AFIT, Department of Operational Sciences

  -- Lt Col Robert Overstreet, Assistant Professor, AFIT, Department of Operational Sciences

  -- Capt Benjamin Hazen, Assistant Professor, AFIT, Department of Operational Sciences

  -- Sponsor, Mr. Thomas Girz, GS-15, AFSC/LGS

Mr. Lafiguera/AFIT/ENS/DSN875-3636x4740/gbl/12Nov2015

Appendix 4: MROi Sample Interview Questions

2015/2016 AFIT MROi Study
(rev. 3)

1. When did you first hear about MROi? What is your current involvement with MROi? Tell me about your experience with MROi…

2. What training did you receive to prepare you to be involved with MROi?
   a) Were you aware of the goals and objectives of MROi?
   b) How have your attitudes regarding MROi changed (if at all)?
   c) In your opinion, what do you think most influenced you to be involved with MROi?

3. Do you think MROi is using lessons learned from ECSS?
   a) What are those ECSS lessons learned that they are applying in MROi?
   b) In your opinion, do you think the application of ECSS lessons learned are effective for MROi?
   c) What are the most important lessons learned in MROi that you have encountered?

4. Are you familiar with the MROi risk assessment process? Tell me about your experience with the MROi risk assessment process…….

5. Are you familiar with the MROi implementation plan? Tell me about your experience with MROi implementation plan……

6. Are you familiar with the MROi business case analysis? Tell me about your experience with the MROi business case analysis…..

7. How do you think the transition or change has gone?
   a) What improvements do you think MROi should apply, as of this time?

8. Is there anything that you like or dislike about MROi?

9. Is there anything you would like to ask me?

Thanks you for your participation in our study. Please contact me in the future if you come up with any other ideas or would like to clarify the things we talked about today.

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Appendix 5: ECSS Sample Interview Questions

2015/2016 AFIT ECSS Study
(rev. 3)

1. What was your involvement with ECSS? Tell me about your experience with ECSS...

2. Did you receive any training to prepare you to be involved with ECSS?
   a) Were you aware of the goals and objectives of ECSS?
   b) In your opinion, what do you think most influenced you to be involved with ECSS?

3. What were the most important lessons learned that you have encountered in ECSS?

4. Are you familiar with the ECSS risk assessment process? Tell me about your experience with the ECSS risk assessment process…….

5. Are you familiar with the ECSS implementation plan? Tell me about your experience with ECSS implementation plan……

6. Are you familiar with the ECSS business case analysis? Tell me about your experience with the ECSS business case analysis…..

7. What actions could we have done differently in ECSS that may have reduced costs and schedule overruns?

8. Is there anything that you like or dislike about ECSS?

9. Is there anything you would like to ask me?

Thanks you for your participation in our study. Please contact me in the future if you come up with any other ideas or would like to clarify the things we talked about today.

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Appendix 6: Thesis Storyboard

A "Big Bang" versus a "Small Bang Approach: A Case Study of the Expeditionary Combat Support System (ECSS) and the Maintenance, Repair, and Overhaul Initiative (MROi)

Mr. George B. Lafiguera

Co-Advisors:

Lt Col Matthew A. Douglas

Lt Col Robert E. Overstreet

Reader:

Capt Benjamin T. Hazen

Introduction

In 2003, the United States Air Force (USAF) embarked on a revolutionary enterprise resource planning (ERP) called the Expeditionary Combat Support System (ECSS). ECSS was a rapid implementation method of an organizational change in the USAF. ECSS was a "big bang" approach to an ERP solution and was considered radical. ECSS failed in early 2012. In late 2012, Air Force Sustainment Center (AFSC) tried to salvage, correct, and continue the work started during the ECSS project through the development of the Maintenance, Repair, and Overhaul Initiative (MROi). MROi is an attempt to standardize work practices and procedures across all Air Logistics Complex (ALC) and Aircraft and Maintenance Regeneration Group (AMARG). MROi is evolutionary. Additionally, MROi is considered an incremental approach that will help enterprise members, vendors, and consultants learn during the ERP transition. However, MROi is plagued with delays that may result to uncontrollable cost increase and schedule overruns.

Problem Statement

- ECSS was revolutionary and ECSS lessons learned were relevant to MROi
- MROi was evolutionary and MROi was an incremental approach that should help organizational members, vendors, and consultants learn during the ERP transition
- Address how well ECSS lessons learned are being applied by MROi decision makers, stakeholders, and SMEs to identify and mitigate potential risks that may result to increased costs and schedule overruns ultimately leading to program failure

Research & Investigative Questions

Research Question: How are the MROi leadership, planners, and subject matter experts (SMEs) applying lessons learned from ECSS to eliminate or mitigate risks for potential cost increase and schedule overruns that may lead to MROi failure?

Investigative Questions (IQ):

1. What are the critical elements of a successful ERP adoption and implementation?
2. What root causes, critical factors, elements, and/or issues contributed to the failure of ECSS? [i.e. ECSS Root Causes (RC) & ECSS Contributing Factors (CF)]
3. Has the MROi team encountered the same root causes, critical factors, elements, and/or issues?
4. How did the MROi team mitigate these risks?

Literature Review

The literature review and case study identified critical success factors (CSFs), antecedents, and theories for successful adoption or implementation of ERP systems. CSFs, antecedents, and theories offer a possible solution to avoid failure of an ERP project. Table below shows that governance issues existed during ECSS and MROi ERP projects. Governance is a circumstantial factor to attain organizational readiness for change. Therefore, there is a probability that organizational readiness for change may not be fully attained during the MROi project, which may result to cost increase and schedule overruns that may ultimately result to program failure.

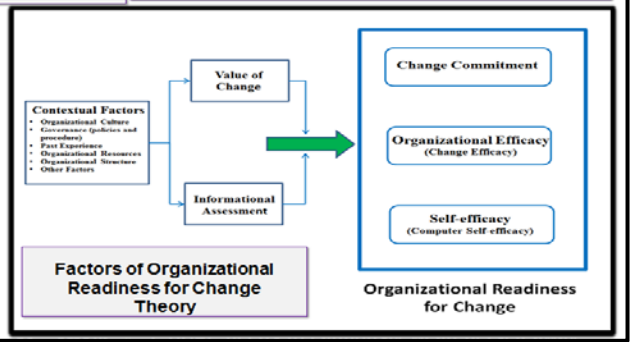
Methodology

- Multiple Case Study: ECSS and MROi ERPs
- Literature review: Critical Success Factors (CSF), Process Theory, & Organizational Readiness for Change (OGRD) Theory
- Data Collection: Archival records, documents, interviews, direct observation, & participant observation
- Analysis: Analyze ECSS and MROi implementation plans, root causes, and contributing factors
- Purpose: Address how well ECSS lessons learned are applied by MROi leadership and support staff
- Limitations: Subjectivity, relies on memories and judgement, no fixed limits, and dependency on current situation

Managerial Implications

1. ECSS was not a total failure
2. ECSS was the first step to truthfully recognizing and discovering the enormous task of transforming the USAF into a more capable organization
3. USAF needs to cautiously wean herself away from using legacy systems
4. USAF needs an all-inclusive awareness of the end goal for a global ERP solution before mandatory ERP system compliance via ERP strategic planning

ECSS ROOT CAUSES AND CONTRIBUTING FACTORS	MROI	Critical Success Factors (CSFs)										
		Monitoring and Evaluation of Performance	Influential Project Champion	Top Management Support	Clear Goals and Objectives	User Buy-in, Involvement, Training, and Education	Strategic IT Planning	Teamwork and Team Composition	Vendor Support and Performance	Business Process Reengineering	Effective Communication	Change Management
Data Management	YES						X		X			
Current State Architecture	UNK				X		X	X	X	X	X	
Future State Architecture	UNK				X		X	X	X	X	X	
Transition plan from Current state to Future state	YES				X			X	X		X	
Executable Plan	YES	X			X			X			X	
Right Culture	UNK					X		X			X	X
Development Environment	YES					X		X				X
Governance	NO		X	X				X				
Effective Procedures	YES				X	X	X					
Change Management	YES					X		X			X	X
Maturity	YES					X		X			X	X



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14. ABSTRACT
In 2003, the United States Air Force embarked on one of the largest and most comprehensive logistical transformation to delineate the logistics community's strategy for supporting the warfighter. A key aspect of this campaign plan was to leverage information technology through an enterprise resource planning (ERP) solution called the Expeditionary Combat Support System (ECSS), a "big-bang" approach. In early 2012, the ECSS program was cancelled mainly due to uncontrollable increases in costs and schedule overruns. In late 2012, the Air Force Sustainment Center (AFSC) launched the Maintenance, Repair, and Overhaul initiative (MROi), a "small-bang" approach, to increase enterprise visibility and efficiency across all three Air Logistics Complexes and Aircraft Maintenance and Regeneration Group. Additionally, MROi should fill some of the gaps deferred by ECSS. MROi is a means to salvage, correct, and continue the work started during the ECSS project. AFSC attempts to transform itself into a more capable organization thru MROi while providing savings to the taxpayers from resulting improvements in efficiencies. The MROi team attempts not to ignore lessons learned from ECSS; however, MROi is delayed by acquisition category determination, system implementation source selection and network architecture evaluation, which are out of their control. Critical success factors, antecedents, and theories were discovered that can help develop a framework that may be of great importance to the government.

15. SUBJECT TERMS
Enterprise Resource Planning (ERP), Critical Success Factors, Organizational Readiness

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