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Evaluating Success Factors in Implementing E-Maintenance in Maintenance, Repair, and Overhaul (MRO) Organizations

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This is to certify that the doctoral dissertation by

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has been found to be complete and satisfactory in all respects,
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Walden University
2015

Abstract

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Peter Rocky Toves

MS, Touro University, 2007

BS, Embry-Riddle University, 2004

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Applied Management and Decision Sciences

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Abstract

Despite more than a decade-long process to transition aircraft maintenance practices from paper-to electronic-based systems, some organizations remain unable to complete this transition. Researchers have indicated that while organizations have invested resources in technology improvements, there remains a limited understanding of the factors that contribute to effectively managing technology-enabled change. The purpose of this case study was to identify and explore socio-technical (ST) factors that inhibit an effective transition from a paper-based system to an electronic-based system for aircraft maintenance. A conceptual model applying theories of change management, technology acceptance, systems thinking, and ST theory informed the research. Thirteen participants provided data via semistructured interviews, field observations, follow-up interviews, other documentation, and a questionnaire. Data were analyzed with open and axial coding techniques to identify themes, which were then crosschecked and triangulated with observation and follow-up interview data. Findings revealed communication issues, a fundamental misconception in training, and a false assumption that all personnel easily acquire computer literacy. Benefits gained from this study should assist maintenance, repair, and overall (MRO) organizations within the Department of Defense to improve current and future technology implementation as the research underscores real-life issues from a comparable organization. The implications for positive social change provide a greater understanding of technology-enabled change and contribute to the development of best practices for technology initiatives that address common ST issues in the MRO workplace.

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Dedication

To My Wife Lily

Thank you for supporting me through this long endeavor, the many difficulties with this project, and the entire doctorial journey. Your faith in my abilities together with your consistent encouragement kept me focused on the goal ahead. I could not have done it without your love, patience, encouragement, and faith. I thank you, and I love you very much.

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Chapter 1: Introduction to the Study

Digital transformation continues to modernize government agencies, public corporations, and nongovernmental organizations. For example, under the President's Government Consolidation Proposal, several agencies will consolidate business practices and transform to paperless processes (Office of Management and Budget [OMB], 2013). The goal of this proposal was to improve services and reduce costs by 20% through digital technology efficiencies by 2016 (OMB, 2013). Each of the following organizations identified substantial cost savings and waste reduction in moving to a paperless process (OMB, 2013). Specifically, the Department of State estimated $11.6M in annual savings by converting 360 paper based forms to e-Forms with electronic signature. The National Aeronautics and Space Administration estimated $500M in savings by eliminating paper processes and electronically distributing many of their publications, namely e-presentations and fliers. The Social Security Administration will save $588M by switching from postal mail to email. The Food and Drug Administration is reassessing outdated postage and paper processes and is expected to save approximately $10B in taxpayer dollars by 2016 (OMB, 2013). The benefits of digital transformation are evident in the significant level of cost reduction and process efficiencies. However, the benefit will be delayed when stakeholders are not prepared to change.

Despite success elsewhere, transformation to a *digital end-state* has proven to be less than effective for some aircraft maintenance, repair, and overhaul (MRO) organizations. The primary function of MROs is to operate, maintain, and overhaul

commercial and military aviation products and weapons systems (Vianna, 2009). For more than a decade, ineffective transition has forced an increase in personnel workload, investment dollars, and the need for dual policies and procedures (A. Person, personal communication, 2012). The current study was designed to identify pathways contributing to the failure of this transition, and why the transition has not been achieved as defined by the intentions of users and stakeholders. Moreover, this study provides insight into potential intervention strategies that can positively drive change to reduce or eliminate the consequences of a stalled transition. The current study has social change implications in contributing to transitioning aircraft MRO organizations into the 21st century paperless end-state, saving taxpayers money and increasing efficiency. In the following sections, this chapter provides a background of organizations within the Department of Defense (DOD) and their efforts to transform aircraft agencies to the digital end-state. The chapter includes a statement of the general and specific research problem, the purpose statement, research questions, definitions; and the nature of the study, assumptions, potential limitations, and conclusions.

Background of the Study

For more than a decade, organizations within the DOD responsible for the maintenance, repair and overhaul of various aircraft and associated components have attempted to transition into the 21st century with digitized processing systems, specifically for aircraft maintenance. These MRO organizations use technical manuals (TMs) to maintain, operate, and repair aircraft and associated its support equipment. For example, one DOD department and its MRO organizations has more than 100,000 active

TM increments and approximately 3,500 paper TM library accounts positioned world-wide (Enhanced technical information management system, program management office [ETIMS, PMO], personal communication, May 2, 2011). Technical manuals are available in a variety of formats including paper, CDs, tapes, and card stock. Examples of technical data include, wire diagrams, schematics, flight manuals, checklists, job guides, and maintenance manuals. Electronic TMs will replace more than 13 million paper pages and numerous paper-based management processes (Airman, 2011). Consequently, in 1996, the DOD determined that digital information systems would be more efficient and cost effective. Subsequently, departments within the DOD began digitization of TMs for all aircraft MRO organizations.

Beginning in June 1996, the Under Secretary of Defense for Acquisition and Technology required the Chairpersons of the Joint Chiefs of Staff of all military departments to modernize all processes to an all-digital environment (A. Airman, personal communication, June 4, 1996). The idea was that "the acquisition of data in a digital format offers numerous benefits to the department, most of which translates to cost savings" (A. Airman, personal communication, June 4, 1996, para 1). The use of digitized methods was expected to automate many processes, eliminate redundancies, and increase efficiencies at all levels in the DOD that otherwise, depend on the U.S. Postal System. This effort has proven to be challenging and current MRO maintenance processes have not reached the desired end-state.

In an effort to effectively monitor transition to the new digital end-state, one department within the DOD established guidelines, milestones, and a corporate goal to

reach the paperless end-state by 2002 (A. Airman, personal communication, June 2, 1996). When the goal could not be reached, it was reestablished for 2012 (B. Airman, personal communication, May 10, 2008), and again for 2014 (C. Airman, personal communication, Sept. 2012). Implementation of full digital operations for aircraft MRO organizations has lingered for more than a decade. Martin and Huq (2007) postulated that technology implementation failures could be the result of narrow focus on the technology initiative alone rather than on the overall goal.

In an effort to smooth transition, one department, the U.S. Air Force (AF), published several authoritative documents that directed and conceptualized the digital future for its aircraft MRO organizations. These documents include: the USAF TO Concept of Operations (2012, 2000); eTool/eTO Technical Order (2011); AF Maintenance for the Twenty-first Century Strategic Plan (2011); MAJCOM eTool/eTO Fielding Plan (2009); AF Capabilities Document (2006); and the AF Transition Roadmap (2002). The documents justified transition, provided vision, goals, desired state, and standardized equipment requirements. However, while it identified why and when to implement the transition, it did not explain how to achieve the goal.

Transition has affected thousands of aircraft MRO employees, program managers, and leaders accustomed to traditional business practices. After more than a decade, one department within the DOD remains under 70% completed across all aircraft maintenance organizations (D. Airman, personal communication, Feb 2013). The inability to fully change to a digital end-state has created persistent fiscal challenges and a long-term obligation to maintain and distribute both digital and paper formats for those

who transitioned and those who have not (A. Person, personal communication, April 2, 2013). Thus, the importance of this research is based on not only the effects aforementioned but on the social and economic problem in continuing this norm.

Research based on major change enabled by technology is not uncommon. Venkatash et al. (2003) postulated that the use of modern technology requires personnel to unlearn old methods and acquire new skills-sets to perform different functions. Consequently, the rate of adapting to the new technology can be affected by the individual's current knowledge and motivation to learn. In many cases, the complexity of change and the differences in individual learning curves are significant factors in technology acceptance. This may be especially true with personnel who lack required computer skills or computer self-efficacy. Computer self-efficacy is the technical knowledge learned through education, training, experience, and the use of computers. Kwahk (2008) proposed that attitude and computer self-efficacy are the two characteristics that may affect technology adoption behavior by way of perceived usefulness for technology systems. User expectations and age are other factors that can influence technology adoption.

A field study conducted by Miller, Brooks, and Winick (2008) examined the expectations of users and information systems within organizations and found that user expectations varied significantly between the ages of 20-29 and 40-49. The findings revealed that managers needed to spend more time addressing user expectations instead of concentrating on modifying perceptions (Miller et al., 2008). As an example, the AF Personnel Center (2013) reported that DOD civilians in the AF workforce are generally

older, averaging 47.5 years old versus their military counterparts, who range between 29-35 years old. Thus, user expectations and age may be a significant factor connected to the fragmented transition to digital processes.

Studies in change management have contributed to understanding people, technology, cultures, and how organizations manage change (Gotsill & Natchez, 2007; Laura-Georgeta, 2008; Martin & Huq, 2007). Several authors have suggested that implementation of IT is more effective when coupled with change management strategies and that change methodologies are key to technology acceptance (Gotsill & Natchez, 2007; Laura-Georgeta, 2008; Martin & Huq, 2007). Lewin's (1951) classical change model suggested that change is a three step sociological process. Lewin (1951) termed these steps: unfreeze, move, and refreeze. Lewin (1951) suggested that during major changes, any social barriers that inhibit acceptance to change should be identified and addressed for change to be successful. This action would help to unfreeze affected attitudes from the past behaviors, move them towards change then refreeze the new behaviors to the new norm (as cited in Schein, 1995). In considering Lewin's change model and more than a decade of transition, it is conceivable that transition to a digital end-state is impeded by this process. In applying this theory, the current study includes an exploration of the barriers that inhibit technology-enabled change.

There is extensive literature available that explores various change theories, models, and methodologies for effectively implementing IT systems in general (Davis & Venkatesh, 2000; Fishbein & Ajzen, 1975; Venkatesh et al., 2003). However, there is little empirical research that explores the effectiveness of change management for IT

implementation within DOD and its MRO organizations. To address this gap in the literature, an exploratory case study can provide needed data analysis to develop evidence to help leaders to make informed decisions about potential strategies that will drive change to its desired state and reduce. These findings have implications for eliminating the taxpayers obligations associated with maintaining multiple processes for the same program. The next section includes the research problem that motivated the study.

Problem Statement

Through the use of electronic manuals and eTools, DOD officials intended to transition the AF war-fighter into the 21st century and a paperless maintenance environment. The problem was that despite the investments in technology, there was a limited understanding of the factors that contributed to effectively managing technology-enabled change. For more than a decade, departments within the DOD have worked to transition MRO organizations to a digitized maintenance environment. This sluggish changeover has created fragmented implementation, complex processes, dual sustainment issues, as well as wasted resources and tax dollars (A. Person, personal communication, April 2, 2013).

A review of historical change management theories and technology acceptance approaches identified models designed from a managerial perspective (Martin & Huq, 2007). Breakdown often occurs due to the lack of awareness among key stakeholders who implement change. For example, McKinsey's 7S' framework postulated seven important elements that make organizations successful towards change (Singh, 2013). The constructs included strategy, structure, systems, skills, staff, style, and shared value.

The model emphasized transformational leadership, process flow, and internal communication and their effect on interrelationships among all levels (Singh, 2013). Thus, underscoring leaderships need to understand, cultivate, and capitalize on organizational dynamics, which include the perspective of front line personnel engaged in the implementation process. This study builds on this understanding by applying an exploratory case study design to identifying the perceptions of key stakeholders and primary implementers of the digital-change over process within an MRO.

Purpose of the Study

The purpose of this exploratory case study was to identify the ST factors that inhibit an effective transition from a paper-based system to an electronic-based system for aircraft maintenance. The ST concept is understood as the interaction of people and technology in the workplace with an emphasis on joint optimization (Mumford, 2006). Observing and capturing data regarding how stakeholders perceive the value, use, management, and ease of working with eTool (laptop computers) and electronic technical manuals (eTM) in lieu of paper provides the basis of this research. This study provided the additional benefit of developing a sense of urgency about needless taxpayer responsibilities as a result of ineffective but correctable technology transition.

An exploratory case study provided the first step in explaining factors that drive a phenomenon through its flexibility in identifying unknown variables. The intent is to capture essential information and identify those critical factors that inform organizations about the perceptions, attitudes, and challenges stakeholders face when implementing large-scale technology systems. Rigor was applied to this qualitative study through the

application of a structured conceptual framework, the force field analysis (FFA) as a part of the bounds for this case. The next section presents the research question driving the study.

Research Questions

The research question is formulated to address the problem statement and to understand the potential influences stakeholders perceive as important to the phenomena that was investigated in the study. In the current study, the purpose was to explore potential factors that influence a process. Specifically the research question was: What are the ST factors that have inhibited the transition from a paper-based system to an electronic-based system in MRO organizations?

Conceptual Framework

The conceptual basis for this study included a broad range of factors that influence technology-enabled change. Specifically, ST theory influences enterprise-wide implementation of digitized technology and processes in aircraft maintenance organizations. The term *socio-technical* denotes the importance of integrating humans with technology in the workplace such as identifying that an interrelationship exists among these systems (Ulhoi & Jorgensen, 2010). Socio-technical theory considers the interrelationship between organizational elements that include structure, tasks, people, and technology (Akbari & Land, 2011). For aircraft MRO organizations, the shift to a digital paradigm affects all organizational ST components. Socio-technical theory and more specifically ST elements inform this study in the following ways: tasks—a paradigm shift from manual to electronic business practices and processes; technology—

technology acceptance and usage; people—resistive behaviors, external influences, and attitude towards digital implementation; and structure—a change in management and organizational structure as an outcome of the changes in the previous three elements. For the study, I employed an integrated change management and FFA framework. The FFA was designed to help identify factors or forces that influence, drive, or impedes change and is explained in Chapter 2.

Nature of the Study

The objective of this study was to determine factors critical to the successful implementation of eTool/eTM technology in one MRO organization. To accomplish this, an exploratory case study was most appropriate, as previously explained, to identify factors based on experiences, perspectives, and viewpoints of MRO organization employees who were key stakeholders in the implementation of the digital transition. As mentioned previously, an exploratory case study is an appropriate design for this research when there is a need for an in-depth investigation that explores a program, event, activity process, or individuals (Creswell, 2013). Further, this is the most appropriate design for exploring a phenomenon or factors that affect a process (Yin, 2013).

A qualitative design is appropriate rather than a quantitative approach because a qualitative approach is unconstrained, descriptive, and flexible (Yin, 2009; 2013). In addition, a qualitative design can include multiple data sources that can support and explain the reason things are the way they are (Creswell, 2013). It is an ideal approach when exploring people's experiences and perspectives within a natural setting (Creswell, 2013). In contrast, a quantitative method will not provide the ability to explore various

perspectives and experiences of people (Patton, 2002). A more detailed explanation of the research design is covered in Chapter 3.

Definitions

Definitions of terms were paraphrased to ensure understanding of operational meanings and concepts.

Computer self-efficacy: The degree to which a person can perform a task using a computer (Davis, Bagozzi, & Warshaw, 1989).

Electronic Technical Manuals (eTM): A digital technical manual file distributed either on physical media (e.g., CD/DVD) or via an electronic means and viewed electronically at the point of maintenance (Command X, 2013).

Electronic tools (eTool): ETools are the hardware required to view electronic technical manuals. ETools include laptops, desktops, hand-held devices, and associated storage cabinets (Command X, 2013).

Enhanced Technical Information Management System (ETIMS): A technical order management system used to manage, store, distribute, and control the configuration of technical manuals (E. Airman, personal communication, June 6, 2002).

Implementation: The degree to which a technology system is incorporated into the organization and encompasses all processes involved in getting the equipment operating properly in the environment (Rouse, 2007).

Information technology (IT): Hand (2011) defined IT as the hardware and software used to store, retrieve, and manipulate information.

Major command (MAJCOM): Represents a subdivision or component of the DOD with a specific mission. The MAJCOM is responsible for the management, command and control of specific military weapons systems, and support equipment (Command X, 2013).

Maintenance, repair, and overhaul (MRO): A term used in the aerospace and defense industry and defined as "quality management system for organizations whose primary business is MRO services for commercial and military aviation products" (Vianna, 2009, para. 3).

Repair centers (RC): An RC is an organization possessing the responsibility for the sustainment of a specific weapons system to include the related technical manuals. An RC is also dedicated to logistics operations and typically performs depot level maintenance, repair, and overhaul for all DOD aircraft (Command X, 2013).

Socio-technical: A methodology or approach that recognizes an interrelationship exists among technology and humans in the workplace and the importance of effective assimilation (Mumford, 2006; Ulhoi & Jorgensen, 2010).

Technical manuals: Command LX (2014) defines technical manuals as "publications containing instructions for the operation, maintenance, training, and support of weapons systems and associated support equipment" (p. 19).

Technical order distribution officer/office (TODO): An individual responsible for the care and maintenance of the technical manual program, currency of data, and policy enforcement. Create libraries within the technical manual management system and ensure eTools are setup for use (Command X, 2013).

Technology-enabled change: The arrangement of information technology to facilitate changes in the practices, processes, and structures of an organization (Kling & Tillquist, 2000).

Assumptions

Several assumptions affect the current study. First, I assumed to gain temporary access and permissions to the aircraft maintenance units, support sections, and conference rooms at predetermined and coordinated times. The study was conducted during maintenance and aircraft flying operations to properly observe the real environment. Second, I assumed that participants would respond openly and honestly given confidentiality and anonymity. A final assumption was that this study would have value to both the MRO organization in potentially improving technology implementation efficiency and to those responsible for stewardship of funds, public or private in creating cost savings.

Scope and Delimitations

The scope of a case study has important implications as it proves the boundaries of the case study in geography, participant selection, time periods, and data type collected (Yin, 2013). An exploratory case study allowed for identification of evidence to why, after more than a decade, full implementation of eTool technology has yet to be achieved by some MRO organizations within the DOD. A structured force field analysis framework provided an opportunity (Lewin, 1951) to categorize the nature of the factors identified, specifically whether they hindered the process. The unit of analysis for this

exploratory case study was a single DOD installation where participants were experiencing this change phenomenon in digital transformation.

Data collected were identified limited to the perceptions of participants relative to influences technology acceptance, challenges, and explanations for possible ineffectiveness, as well as observations, field notes, and archival data review. The information gained from this case study may be partially transferable to most DOD MRO organizations in similar circumstances. This is because the maintenance culture and parameters of such installations are very similar across geographies. The significance of these findings are also potentially transferable to other organizations outside the DOD as the transition to a digitized process is not isolated to just one organization within the DOD (S. Teate, personal communication).

Limitations

Organizations responsible for aircraft MRO organizations are unique in geography and type (security protocols) therefore; special privileges were required for access and permissions. Personnel responsible and who work for MRO organizations have rigorous work schedules and demanding maintenance practices. One major limitation was the availability of participants for interviews during flying/operational hours. Managers, supervisors, and maintainers are busy. Their responsibility for correcting aircraft on flying schedules remained a priority over this study.

An applied strategy assisted in mitigating the effect on this rigorous scheduling on potential data collection setbacks. First, scheduled observation sessions occurred during low flying hours. Second, individual interview sessions occurred transpired during off

work hours. Third, identification of participants and scheduled sessions occurred in advance (Del-Rio-Roberts, 2011). Fourth, reminders helped to ensure participants would be available. Fifth, one-on-one interviews were rescheduled when necessary. Finally, observational activities took place at the participant's earliest convenience.

Another limitation was that the sample size was restricted to 20 participants or until saturation occurred. This study was conducted on one active aircraft maintenance installation where data collection activities had to be stringently coordinated. Specifically documentation review and nonintrusive observation sessions were conducted during work hours and interviews during lunch period. Although, there was not any direct interactivity on two of the three events, the interviews consumed approximately 20 hours of personnel participation. Therefore, participants for the study were limited by the organization prior to the study's implementation. Despite this limitation, research has supported the sample size as appropriate for an exploratory case study (Creswell, 2013; Yin, 2013). Additionally, the sample size was sufficient to reach saturation by the total of 13 participants mitigating any concern about the sample limitations, as further explained in Chapter 3, and identified in Chapter 4.

Significance of the Study

The current study has important implications for practice theory and social change. Technology-enabled change and people should not be expected to automatically integrate to work as one cohesive system. The significance of the study is further broken down to types as explained in the following subsections.

Significance to Practice

By identifying user-defined factors, future technology plans can incorporate an empirical roadmap that contributes to the development of best practices for technology initiatives that address common ST issues, which linger as a result of technology-enabled change. The implications provide a greater understanding for effective transformation of aircraft maintenance practices that modernizes and improves the effectiveness of the MRO organizations in the 21st century.

Significance to Theory

Based on the background of this study, it is conceivable that some MRO organizations within the DOD rarely implement technology initiatives based on change factors derived from the perspectives of end users. However, the results and benefits derived from the study are expected to contribute to improved technology acceptance and efficient use of taxpayer resources by conceptualizing change theory with a force field analysis and reporting important findings. Moreover, by applying the integrated research framework and an exploratory qualitative methodology, this study may contribute to a gap in the literature by recognizing user-defined factors critical to technology acceptance and integrating them within a change management philosophy that positivity drives technology-enabled change.

Significance to Social Change

The significance of this study towards social change cannot be overstated. The current process used to distribute data to MRO organizations and associated components employs dual processes for maintaining and distributing technical information, which

contributes to considerable waste of resources and tax dollars (A. Person, personal communication, April 2, 2013). The sluggishness of more than a decade of transition to a digital end-state has created fragmented implementation and complex processes across MRO organizations with an aircraft maintenance objective (D. Airman, personal communication, April 2, 2013). Thus, leaders and technology planners must seek effective approaches to assimilate both technology and people processes equally so that the final end-state can be achieved.

Summary and Transition

This study highlighted the socio-technical issues that result from technology-enabled change and the importance of change management. For the past 5 decades researchers, scholars, project managers, and organizational leaders (Kotter, 2008; Lewin, 1951; Momeni et al., 2012; Murthy, 2007; Popesecu, 2009; Trist & Emery, 1960) have worked to understand why humans have difficulties in adapting to change. Whether the problems arose from poor communication, lack of skill-sets and training, or poor project management; it appears that one solution does not fit all.

This chapter covered the background and problem of the study and how change is affecting technology acceptance in MRO organizations within the DOD. The chapter explained the purpose of the study and its significance to developing a more effective method of transitioning into a digital end-state. Finally, a conceptual framework was presented that applies change theory, technology acceptance models, and a force field analysis framework as a basis for the study's approach.

Chapter 2 includes the understanding of this study by synthesizing literature from various theorists, technology acceptance models, and change management philosophies. It focused on research that identifies human factors that influence technology adoption and explores the significance of leadership roles in organizational change. To further justify the importance of the study, the chapter covered the complexity of technology-enabled change using a real example within the DOD. Chapter 3 includes the methodology.

Chapter 2: Literature Review

This chapter includes a comprehensive review of theoretical concepts and models that contribute to understanding the socio-technical issues of technology-enabled change within organizations. These theories draw from physiological and sociological perspectives from models such as the technology acceptance model (Davis et al., 1989), general systems theory (Bertalanffy, 1972), and Lewin's (1951) force field analysis. Results from this research suggest positive and negative factors that might have significant influence on the effectiveness of technology-enabled change; and address the potential effects on people, processes, structure/culture, and leadership (Bhattacherjee et al., 2009; Melitski et al., 2010; Murthy, 2007). There has been extensive literature written from multiple perspectives that addresses approaches of dealing with technology-enabled change.

This literature review begins with a worldview of 21st century technology and the emerging transformation of organizational culture towards digital processes. The literature is built upon by underscoring technology management relative to change management and research models. The review further explores the role of leaders in preparing the organization for change and ends with the research model that drove this study and the phenomena for investigation.

A review of the literature demonstrates a tie between technology-enabled change initiatives and organizational change management. Further, this review provides documented factors that helped to conceptualize the problem of why after more than a decade technology-enabled change has not been fully realized in aircraft maintenance

organizations. The study uncovered explanations for this phenomenon by exploring and identifying factors, which influenced the implementation of technology, specifically in MRO organizations within the DOD.

Literature Search Strategy

This section provides a description of the methods and tools used to search, identify, and analyze the articles and information presented in the study. Additionally, this section presents the keyword and databases used to develop this proposal. In developing this research proposal, I conducted a wide-range review using a variety of strategies, resources, and tools. As the investigation is based on technology acceptance and change management in an MRO organization context, the first critical review of journal articles related to keywords such as *organizational change, technology, technology-enabled-change, organizational culture, change theory, change management, technology acceptance, AF, strategic planning, leadership,* and *management.* Results were queried using the Walden University library search databases EBSCOhost and ProQuest. I also obtained other information from external sources such as online articles and physical books, local library book reviews, AF briefings and personal communications. Other information came from, AF personnel demographics, AF Instructions, and DOT & E (1999) annual report. Citations from the mentioned sources support this proposal and are most integral to its credibility.

Conceptual Framework

Researchers often combine theoretical perspectives in an overall framework to examine a problem in a different way. This idea inspired the researcher to an integrated

framework that will explore the socio-technical issues of technology-enabled change. This study used an integrated framework including a combination of force field analysis (Lewin, 1951) change theories, and technology acceptance models (Davis & Venkatesh, 2000; Fishbein & Ajzen, 1975; Venkatesh et al., 2003). For further details on this framework, see Chapter 3.

Socio-technical Theory

Socio-technical theory is the underpinning idea in this study, which conceptualizes technology-enabled change from both the social and technical dynamic of the organization. Socio-technical theory emphasizes the importance of the integrating humans with technology in the workplace; recognizing that an interrelationship exists between these two systems (Mumford, 2006). Socio-technical theory refers to the organization as comprising of two subsystems, a technical subsystem and a social subsystem.

The technical system includes the tools, technology, and techniques used to innovate and economically improve output of the organization. The social system consists of employees, skill-sets, knowledge, values, attitudes, and group relationships rooted within the organization. Thus, socio-technical system design ensures that technology and human issues are given equal weight whenever possible with emphasis on joint optimization (Chern, 1976; Jorgensen & Pulhoi, 2010; Mumford, 2006). For MRO organizations and its decade long transformation, it is conceivable there are socio-technical forces influencing effective implementation of technology thus, the motivation for this study.

Force Field Analysis

For this research, a FFA framework was used to identify factors that drive or impede technology-enabled change. Force field analysis is a framework based on the change theory developed by Lewin (1951) and used in this study to underscore the dynamic socio-technical process that affects technology-enabled change in an MRO organization. This framework helps define the dynamics of human behavior when change is introduced or when the status quo is disrupted. Specifically, this framework was used to explore the ineffective shift from a paper to a paperless paradigm. Lewin (1951) identified two types of forces that influenced change. He named these concepts *driving* and *restraining forces*. A driving force is an influence that encourages change, such as a person of importance (Manso et al., 2013), an organizational policy, or some type of incentive. Restraining forces are those forces that fight to maintain the current status quo and include negative experiences, fear, learning, anxiety, and loss of control (Bozak, 2003; Shein, 1995). Restraining forces act by maintaining a behavioral equilibrium by countering potential change forces. Behavioral equilibrium is developed from past learning, environmental conditions, and cultural influences. Since MRO organizations have worked within the same maintenance concept for more than 60 years (1947), behaviors are restrained as a result of personal, cultural, group, and community norms (Kotter, 2008). Lewin (1951) postulated that if restraining forces were removed or lessened, change would more likely take place.

According to Lewin (1951) and FFA principals, three key actions must take place for change to occur. Specifically, change agents must identify, determine, and develop.

First, identify contributing and inhibiting factors or forces that influence behaviors. Second, determine which forces or factors can be controlled or positively manipulated to drive change. Third, develop recommendations or action plans for positive change. For example, if weak computer skills are identified as an inhibiting factor of technology acceptance, then it is conceivable that this factor could be manipulated with a computer training strategy that positively drives the desired change. Force field analysis is a valuable tool that can "help leaders and other stakeholders [to] identify, document, and understand forces that influence plan[s]" (Schwering, 2003, p. 361).

Force field analysis has been applied as a research methodology in several qualitative studies across various disciplines. It has been used to identify factors that influence the application of research to practice among violence prevention workers (Graf, 2011). Force field analysis has been used to identify appropriate staff levels and training shortfalls for a progressively busy hematology day ward (Baulcomb, 2003). This method has also been used as a decision tool to determine whether teachers perceive the Turkish educational system as ready to implement educational change (Gökçe, 2005). In all of the above instances, FAA was used to determine factors that influence change; thus, evaluating those factors for better decision-making. In addition to identifying critical factors, this research methodology allows for the development of action plans and intervention strategies that will drive positive change.

The change management focus of this proposal's framework includes concepts from change theories and from technology acceptance models that will be used to inform the study. This is especially important because organizational change, specifically,

technology-enabled change is the established groundwork for the FAA (see Chapter 2). The FFA helps to better define the potential factors that influence change, mentioned above and provides a means to examine the phenomena and program under investigation (Cronshaw & McCulloch, 2008). In all, the framework described in this chapter is designed to create a holistic understanding of the underlying issues relative to the aspects of technology usage, acceptance, attitudes, and feelings (Yin, 2009). The literature review examined the key body of works that support the theories, concepts, and motivation for this study.

Literature Review

Global Digital Transformation

There is a current transformation toward a digital society. Innovative ideas are slowing construction of brick and mortar businesses and digital and electronic services are replacing physical locations and paper processes. New terms continue to distinguish a shift towards digital operations that include ecommerce, eservices, e-tailing, e-Biz and more. This trajectory towards digital efficiencies and paperless processes is evident in U.S. organizations. For example, the U.S. Bureau of Labor Statistics (2004) predicted a 10% decline in the print industry by 2014 as a result of digitization. The availability of less expensive electronic books (Spector & Trachtenberg, 2011) caused one of the nation's largest bookstores, Borders, to close its doors. To stay competitive the music and movie industry followed the evolution. These industries not only digitized their products but also reengineered their distribution, storage, and purchase processes as well. The change to digital technologies has slowed the need for physical presence, and expanded

the reach to consumers, governments, and businesses of other economies and other revenues. However, these examples also suggest a required change in current workforces that incorporate new technical skill-sets (Landry et al., 2005; Long, 2010). In MRO organizations, technical skill-sets vary because the workforce is comprised of military personnel, contractors, and civil servants (AF Personnel Center, 2013). These groups differ significantly in age, experience, and technology competencies (AF Personnel Center, 2013). This creates significant challenges in implementing tools that will help develop this nontechnical professional workforce.

Organizational Change

As organizational growth and technology efficiencies emerge, organizations must evolve to improve their effectiveness. Information technology can be a significant driver of organizational change "because of the technology involved and the difficulties of determining stakeholder readiness for adoption and understanding" (Long & Spurlock, 2008, p. 35). Technology-enabled change can affect organizations and their processes on more than the intended level across training, resources, organizational alignment, and culture (Gouker, 2009). Consequently, leaders must consider the organization as a whole and the potential effects on other organizational components when planning change via technology (Banathy, 1992; Bertalanffy, 1968; Kemp, 2006). Leaders who elect to retain current workforce structures must address human factors that will support the assimilation of technology and people into a cohesive organizational system (Mumford, 2006). These factors may include individual support, communication, training, exposure to system functions, demonstration of commitment to the IT, and follow-up

reinforcement (Thome-Diorio, 2009). New technology can disrupt organizational norms, divide common beliefs, and change the culture of an organization. Therefore, user acceptance is critical to the successful implementation of technology-enabled change. Although new information systems can increase organizational performance and work processes, radical technology-enabled changes can affect organizational culture and the system status quo (Martinson et al., 2009). Thus, the challenge is developing a culture that embraces technology-enabled change.

Organizational Culture

People react differently towards change therefore, understanding the organization's work culture is paramount. Technology-enabled change often encounters resistance within organizations (Long, 2010). This could be the result of an established organizational culture. Organizational culture is defined as common beliefs, attitudes, and values shared within a group or team; a pattern of beliefs resulting from norms and formal activities (Momeni, Amir, & Saadat, 2012; Popescu, 2009). Therefore, it is important to understand that "organizational culture is a powerful restraint of change specifically, on technological change" (Murthy, 2007, p. 121). Historically, socio-technical theory suggested that effective implementation of technology systems required the assimilation and optimization of both people and technology (Trist & Emery, 1960). Consequently, the challenge is to realign past cultural norms to adapt to the technology-enabled change. However, change could be problematic for leaders whose employees are deeply rooted in processes, which they perceive as effective (Kotter, 2008). This is because a proposed change in work methods can run counter to the expectations, values,

and attitudes of the work group (Popescu, 2009). Therefore, leaders must consider the culture of the organization and the potential effect of technology-enabled change and plan accordingly.

The employment of electronic TMs and its associated technology is not a typical process change or system upgrade; it is essentially a paradigm shift. This new paradigm requires organizations to completely transition from one mindset or culture to another. The shift to a digital environment affects the organizational culture at various levels. It not only transforms the processes in which it replaces, but also affects personnel technical skill-sets and contrasts with past norms. Thus, new learning must take place, technical or computer skill-sets must advance, and people accustomed to a process designed in the 1940s must adapt to a new electronic culture (AF transformation roadmap, 2002). The digital paradigm shift assured challenges in change management, technology acceptance, and transition for all MRO organizations within the DOD.

Organizations must manage change to capitalize on, innovative ideas, technology, and to transition towards an organization's desired end-state. To enable transition to the digital paradigm, leaders should lead front line management towards building culture favorable to change (Popesecu, 2009). Martinson, Davidson, and Martinsons (2009) examined the influence of technology-enabled change for 12 sample firms and found that both organizational change and technology are likely to succeed if they "fit in the implementation context" (p. 122). The implementation context refers to recognizing and understanding the differences between the new and old processes and developing an implementation approach based on the present norms or to what the recipients are

accustomed. For example, organizations accustomed to achieving goals based on employee empowerment would ensure employees are involved in decision-making. Conversely, organizational change that is demanding or forced in nature and lacks employee empowerment creates the risk for resistive behaviors and slowed implementation (Martinson et al., 2009). Thus, for technology-enabled change to be successful, managers must recognize critical issues specific to the organization's implementation context.

Change management. Change management is a method used to control an organization's transition towards a future end-state. Change management is the key to effective technology implementation and requires controlling negative perceptions that enable resistance (Sutanto et al., 2008). Regardless whether simple or radical, people resist technology-enabled change for many reasons. One reason may be that people do not understand the objectives driving the change (Gotsill & Natchez, 2007). Change management is a process, strategy, or set of tools used to transition an organization from the current state to a desired state. Its purpose is to help organizations control potential issues or overcome obstacles associated with change (Kotter, 1995). Change management strategies focus on people, processes, and technology factors caused by change initiatives or new technology introduced into an organization (Murthy, 2007). A study conducted in 2009 by the Blanchard Company revealed, "70 percent of all change initiatives fail and 29 percent are launched without any formal structure whatsoever" (p. 44). The study cited two main reasons for change failures. First, some believe that announcing change is the same as implementing it. The second reason for failure is employee concerns about

areas for which change has not been addressed (Blanchard, 2008). Issues that surface after the change is implemented are harder to fix. Thus, change management is a technique or process that prepares an organization, group, or team of individuals to accept something other than the status quo. For example, Gotsill and Natchez (2007) conducted a study on a brewery distribution company that was losing approximately $5000 a month. A team of change management consultants' motivated the workforce to change their work processes when they demonstrated that the company was losing money as a result of their work process and habits. Gotsill and Natchez (2007) explained that by depositing a quarter in a pickle jar for every successful shipment and removing $10.00 for every shipping error, this change was achieved. The demonstration captured the attention of the organization's internal employees by recognizing real-life losses thereby, established motivation to change work habits (Gotsill & Natchez, 2007; Lewin, 1951). The same company's sales force resisted the use of laptops in lieu of paper. However, once consultants involved the sales team through practice, explained the benefits, and demonstrated cost savings the sales team was able to adopt the technology before it went live (Gotsill & Natchez, 2007). The next section discusses how change and technology acceptance models are used in the study.

Research models. There has been a significant amount of research on technology acceptance and technology adoption. Various theories and models have been established to identify and explain factors that influence technology acceptance (Davis et al., 1989; Davis & Venkatesh, 2003,). Research and factors of technology acceptance vary by model and theory, but they all have one commonality; one size does not fit all. The

following technology acceptance models, relative concepts and strategies are used as a foundation to investigate the phenomena.

Technology acceptance model. Researchers have developed models to better understand the socio-technical issues, which drives resistance to technology-enabled change. Davis (1989) and Davis et al. (1989) introduced the technology acceptance model (TAM). It is widely used by researchers and practitioners to predict and or explain an individual's intention to use information systems. TAM predicts individual intentions in terms of two factors: *perceived usefulness* (PU) and *perceived ease of use* of the IT. TAM observed the socio-technical aspects of the organizational system that influences those individual attitudes that make people accept or reject information systems technology (Davis, 1989). Technology users who believe that a system is easy and will improve their job performance are better motivated to adopt to change. Thus, their intention to use it is positively motivated and perceived use and perceived ease of use is increased (Davis et al., 1989).

Escobar-Rodriguez, Monge-Lozano and Romeo-Alonso (2012) modified the TAM model and investigated the factors that influenced health care personnel to use e-prescriptions in lieu of paper. In this new version, the TAM model was adapted with four additional variables (perceived compatibility, perceived usefulness to enhance control systems, training, and perceived risks) according to Rodriguez et al. (2012). Findings revealed that training correlated with perceived usefulness and perceived ease of use, was a significant influencer to achieving effective implementation, and increased intention to use the hospital system. Rodriguez et al. (2012) stated that TAM was a valid model to

predict the intention of hospital personnel. Conversely, Chuttur (2009) criticized the model during an overview of TAM regarding its limitations, applications, extensions, and criticisms. Specifically, he claimed that although TAM is a highly-quoted model, "research in TAM lacks sufficient rigor and relevance that would make it a well-established theory for the [information systems] IS community" (Chuttur, 2009, p. 1). Aircraft MRO organizations employees generally work in intense work environments. Maintenance tempo is fast paced, consistent, and relentless. Therefore, perceived usefulness and perceived ease of use are important initial factors to the technology users, especially when time and speed effects mission operations.

Davis and Venkatesh (2000) expanded TAM to TAM II, with an additional construct named subjective norms. The subjective norm is an intention predictor that is based on social influences or pressures in mandatory settings (Davis & Venkatesh, 2000). The construct identifies external influences within an individual's social environment and is based on the value placed on others opinions, which may influence ones intention.

In aircraft MRO organizations, where the workforce consists of a blend of civilian, contract, and military personnel the subjective norm predictor of this model may deliver mixed outcomes. This assumes the importance of variables such as power, politics, seniority, contractual language, and position descriptions. For that reason, technology-enabled change management among a group of mixed members becomes much more complicated and important.

Unified theory of acceptance and use of technology model. The unified theory of acceptance and use of technology (UTAUT) was developed and empirically tested by

Venkatesh, Morris, and Davis (2003). It is perhaps one of the most powerful explanatory models in technology acceptance research. The model highlights key factors that affect technology acceptance and also identifies the possibilities that could constrain the effects of these factors. Unified theory of acceptance and use technology is a model integrated from eight widely accepted models and theories that expand the definition of four (of the eight) core determinants or constructs. These core determinants are performance expectancy, social influence, facilitating conditions (Venkatesh et al., 2003), and effort expectancy (Davis, 1989)

Performance expectancy is the degree to which a person believes the system will be beneficial to his or her job performance (Venkatesh et al., 2003). Effort expectancy is the degree to which a person believes that using a particular system would be free of effort (Davis, 1989). Social influence is the degree to which a person perceives that others think he/she should use the system (Venkatesh et al., 2003). Facilitating conditions are the degree to which the user perceives that the organization and the technical infrastructure are created to support the use of the system, such as user friendliness (Venkatesh et al., 2003).

The uniqueness of UTAUT is that it incorporates variables such as experience, voluntariness, gender, and age as moderators to better develop and explain the four mentioned determinants. The strength of UTAUT is in using gender and age moderators. This model allows researchers to apply a more narrow focus on participants, which may provide for better and more definitive findings. The UTAU model demonstrates an integration of eight empirically tested constructs derived from several technology

acceptance models. Developed by Venkatesh and Davis (2003) it is a post adoptive model of user behaviors (Jasperson, Carter, & Zmud, 2005). The UTAUT model assumes that user involvement has a direct link to successful IS implementation outcomes (Venkatesh et al., 2003).

Technology acceptance models provide core constructs and ideas to specific approaches that address behavior stages examined in Lewin's (1951) change model. For example, if an organization identified negative factors relative to perceived usefulness of technology, it is conceivable that a training program could decrease negative attitudes and increase positive perceptions of usefulness (Ji-Tsung & Markus, 2006.) The next section discusses several types of effective IT enabled change strategies.

Strategies. It can be noted that user involvement, is the *moving* stage of Lewin's (1951) change model (previously mentioned). In this model, the moving stage is where users are more open-minded and change gains momentum towards the new norm. The key to success in the moving stage is effective strategies (Lewin, 1951). The purpose of effective IT change strategies is to prepare a group, individual, or organization for new ways of working (Thome-Diorio, 2009). Researchers and practitioners have established various creative ways to implement change. Some have based their change management strategies on project management, software development, leadership principals, or customer relationship management. Yet, they all have the same objective in common; they change the way people think and "prepare individuals and organizations for new ways of working" (Thome-Diorio, 2009, p. 36).

There is an accumulation of empirical evidence within a wide variety of industries suggesting that organizations do not use IS to their full functional potential. Specifically, the success rate for IT is in general quite low (Blanchard, 2010; Ouadahi, 2008; Venkatesh et al., 2008; Warren & Myungsin, 2007). Today, organizational leaders invest in IT efficiencies because their intention is to improve productivity, decrease resources, and eliminate non-value added processes. However, technology-enabled change is not effective if the users who are affected are not committed to its use (Ouadahi, 2008). Thus, implementation problems generally emerge when introducing new information systems and stem from social and organizational shortcomings rather than from the IT initiative itself (Land, 1998; Quesne & Wijegunaratne, 1989). New IT initiatives should consider all aspects of cultural, social, organizational, structural, and IT processes as part of a total program (Land, 1998).

For example, a study conducted by Ji-Tsung and Markus (2006) suggested that IT implementation has a greater chance of success when operational end users are involved in the design and analysis stages of the project's developmental life cycle. The research focused on the effect of user participation. Results revealed that users who participated in either stage of IT development had increased perceived acceptance and intention to use the system. The findings validated user participation as a driver for user satisfaction and intention. Moreover, involvement on the operational level instilled a sense of ownership, accomplishment, self-satisfaction, intention to use, and commitment (Ji-Tsung & Markus, 2006).

Legris and Collerette (2006) supported similar findings that involved stakeholders positively executing change. The researchers incorporated stakeholders as part of an integrated project management methodology called agile software development (ASD). The framework was recognized in early 2000 as "an alternative to classical change management approached at least for some situations" (Legris & Collerette, 2006, p. 66). In this context, ASD workflow processes involved users in planning, analyzing, prioritizing requirements, and testing. The approach inspired teamwork, user collaboration, involvement, incremental development, user validation, and testing. The five-stage ASD model guided participants through elements of project management, technology acceptance, and change management. Though proven effective, this method could strain an organization's resources (Legris & Collerette, 2006). For MRO organizations, the ASD process is difficult without established change agents available to employees as needed.

Key stakeholders. Part of effective change is identifying the key stakeholders in the change process. Top management is the most critical factor to the success or failure of engineer resource planning or ERP (Martin & Huq, 2007). Top management's responsibilities in ERP sometimes include assimilation and implementation actions that potentially overextend scope, control, and expertise. This overextension causes a loss of momentum during the implementation phase. Martin and Huq (2007) found that refocusing scope of authority and delegating implementation responsibilities and tasks to other managerial and technical personnel would help leaders to better concentrate on cultural and environmental issues that strategically add the greatest value on changing

employee's attitudes towards accepting ERP. The method would not only demonstrate management commitment but would also allow specialized personnel to do what they do best, manage the technical issues of the IT implementation more correctly. Restructuring of organizational power for the sake of an ERP project can potentially threaten the control of individual groups within the organizational structure (Martin & Huq, 2007). Thus, the political issues, conflicts, and obstacles that arise require top management intervention and engagement. Hornstein (2008) agreed that dedicated personnel, including change agents and product champions are essential strategists in moving the organization towards change. Hornstein (2008) maintained that consistent information exchange between the various levels of personnel will help improve compliance and shape attitudes, beliefs and values in support for the IT initiative. Further, there will be differences in change agents therefore; they must come from within the organization. Change agents who are outsiders will more likely have a difficulty implementing change (Horstein, 2008). Outsiders unfamiliar with organizational culture or business processes can potentially delay the transition process (Hornstein, 2008).

In the context of a business study, Shun, Shankar, Erramilli, and Murthy (2004) found a positive relationship between customer satisfaction and customer loyalty. Their conceptual framework was based on customer-perceived value, customer satisfaction, and switching costs. Their findings exposed that customer loyalty is influenced by both customer satisfaction and customer-perceived value. In other words, customers that perceive value in a product or service and are satisfied with it are likely to remain loyal in continuing its use, service or patronage (Shun et al., 2004). The study also suggested that

improving perceived value could enhance both satisfaction and loyalty. This study was significant because it provided insight into the social and behavioral constructs that must be addressed for individuals to respond positively towards technology-enabled change.

The above findings are applicable to this study because technology users hold the same position as customers to the organization's chief information officer; both have intentions to use the technology driven by perceived value and satisfaction. Davis (1989) postulated that users who believe a system will improve their job performance are better motivated to adopt the system. Subsequently, their intention to use the system is then positively influenced and increases perceived value and satisfaction.

Technology-enabled change in organizations can be complex in implementation. The affected employees attitudes and behaviors are the key enablers in supporting or resisting the change (Kim, 2008; Kwahk, 2008). Consequently, top leadership should communicate an understanding about why the change is necessary and the importance of the transition. Leaders and managers must understand the positive and negative key organizational factors that influence the effectiveness of technology enabled change and its transition (Brenner, 2008; Levin & Gottlieb, 2009). Management must communicate strategic messages, support new methods, enforce corporation, and provide resources for employees coping with new business practices, monitor, and address resistance (Gotsill & Natchez, 2007).

Leadership Role

Leaders who are effective in implementing change via technology must be capable of seeing the organization from both the technology and social dimensions

(Kwahk & Hee-Woong, 2008). A systems thinking or holistic perspective allows leaders to consider relationships between system components that may be affected by the change. Conceivably, this approach will provide the opportunity to implement change management strategies more efficiently and effectively for change to take hold. Organizational change is not transparent; especially, when coupled with IT change. To ensure organizational readiness and alignment, top leadership should consider the implementation of change management strategies while planning for IT enabled change.

Strategic planning. The Balanced Scorecard Institute (2014) defined a strategic plan as "a document used to communicate with the organization the organizations goals, the actions needed to achieve those goals and all of the other critical elements developed during the planning [exercise]" (para. 2). Effective leaders and planners establish clear organizational objectives, define vision, and set realistic goals that are consistent with the organization's culture, mission, and values. Strategic planning ensures action plans are in place to address potential issues derived from organizational-wide change initiatives. Yet, for some reason, MRO leaders rarely consider integrating change management as part of strategic planning for IT. This has resulted in negative contribution to IT statistics and a compilation of literature about failed IT implementation. Alternatively, change management might need to be executed as a separate entity based on the organization's structure and management philosophies (Pugh, 2007).

Using Lewin' (1951) terms, classical change theory suggested that people must be unfrozen from the status-quo (unfreeze), open to change and new behaviors (move), and stabilized (refrozen) to the new norm for change to take hold. It has been proposed that

IT lead planners who failed to understand this concept have caused costly and preventable organizational change issues (S. Teate, personal communication, February 19, 2013).

Some explanations why leaders and managers face significant IT implementation issues today are because change issues arise after deploying technology. Consequently, change management strategies turn out to be reactive in nature and implemented late causing user resistance, low productivity, and dysfunctional processes. The term late refers to executing a change strategy after the IT initiative was employed, users become frustrated, or implementation is fragmented. The disadvantage of late strategies is that users develop negative impressions or attitudes, which make it more difficult to unfreeze attitudes and move change along.

From an MRO context, aircraft maintenance organizations characteristically do not plan for or employ formal change management strategies for IT initiatives. This is evident based on the development of numerous implementation strategy documents (see AFMX21 Maintenance Strategic Plan, 2011; Capabilities Development Document, 2006; Technical Manual CONOPS, 2012; Transformation Roadmap, 2002). Hence, change management strategies become a defaulted responsibility of the project managers (generally more concerned about the technical aspects of the initiative), or middle management (not experienced in managing change). In other words, change management strategies are developed ad-hoc, during crisis, or not at all. To ensure management prepares for change, change management requires a consistent top-down communication

process (Carter, 2008). Thus, leaders should develop strategic plans to communicate their vision, goals and a strategy to achieve them.

According to Austin (2009), implementing controversial change from a strategic standpoint can be extremely difficult and a "politically dangerous balancing act" (p. 1). This is because change challenges, tradition, history, and pasts norms, and the "benefit of familiarity" (Long, 2010, p. 207) that supports resistance to change on individual, organizational and industry levels (Austin, 2009). Organizational norms are day-to-day interactions or routine business practices that are part of the culture. Organizational norms exist due to developed beliefs and values learned from the existing status quo, individuals employ these norms as part of the decision-making processes (Momeni et al., 2012). Collectively, employee beliefs and values help to establish the working culture in which managers must understand and cultivate to enable change to take place.

One fundamental goal of this research is to make a convincing argument that integrating change management strategies are essential planning constructs for effective IT implementation. This is because technology acceptance is much harder to achieve after implementation and resistance to change has set-in. "Resistance to change is recognized as a critical important factor that can influence the success or failure of an organizational change effort" (Mansor, Mat, Abu, & Joari, 2013, p. 1). This research explored real-life factors that influence change implementation, organizational readiness, and alignment.

Readiness. Successful implementation of technology typically depends on the organization's readiness for change, but change is not always perceived as positive

(Kanter, 1991). For effective change to transpire, leaders and managers must create a state of readiness. This is accomplished by understanding the organizational culture and determining factors that influence effective change, then applying appropriate strategies that enable change (Madsen, Miller, & John, 2005). Kwahk and Hee-Wong (2009) suggested that readiness preempts the likelihood of resistance, thereby, increasing the potential for change to be more effective (as cited in Armenakis, Harris, & Mossholder, 1993).

Madsen et al. (2005) examined the correlation between readiness for change and two prospective influential factors, namely "organizational commitment and social relationships in the workplace" (p. 214). Organizational commitment is centered on the employee's attitudes towards the organization and their level of acceptance (Madsen et al., 2005). Social relationships in the workplace are defined as employee feelings towards peers, supervisors, and subordinates with whom they work with. In a study of four companies, Madsen et al. (2005) sought to determine whether employees with high levels of organizational commitment and positive social workplace relationships positively influenced organizational readiness. The findings revealed a correlation between organizational readiness, commitment, and social relationships in the workplace. Employees exhibited higher readiness levels when they perceived themselves as involved and identified within the organization (Madsen et al., 2005). Moreover, employees also demonstrated higher organizational commitment levels when relationships between co-workers and supervisors were perceived as positive (Madsen et al., 2005). These results suggest that organizational readiness can be influenced by employee commitment, and

commitment is influenced by the social relationships within the workplace. Additionally, the results indicate that leaders and managers can influence organizational readiness for change by implementing strategies that assist in increasing organizational commitment such incentives, job involvement, and identification and awards programs. Holt, Achilles, Hubert, and Stanley (2007) stated:

> Readiness for change was defined as a comprehensive attitude that is influenced simultaneously by the content (i.e., what is being changed), the process (i.e., how the change is being implemented), the context (i.e., circumstances under which the change is occurring), and the individuals (i.e., characteristics of those being asked to change) involved. (p. 235)

In a rapidly-changing environment, leaders must be able to think out of the box. This is because organizations are becoming more complex as technologies are implemented and processes are reengineered. By understanding how technology-enabled change can affect more than a single process presents new challenges for managing and interpreting patterns in organizational inefficiencies (Palima & Skaržauskiene, 2010).

Systems theory. Components within an organization are integral to a cohesive organization and its overall effectiveness. Systems theory provides a world-view perspective on component relationships. Author and biologist Von Bertalanffy introduced general systems theory in the 1920s (Kemp, 2006). General systems theory postulated the presence of "systems laws that manage the organization of the numerous entities of a system, whether biological, social, mechanical, or other" (Kemp, 2006, p. 22).

Banathy (1992) addressed the complex nature of a system and defined it as "an assemblage of inter-related elements comprising a unified whole of components which are connected together in order to facilitate the flow of information, matter or energy" (Kemp, 2006, p. 22). Concepts of systems theory view organizations as systems because of their arrangement of components, subsystems, or entities that support the organization as a whole. A systems theory perspective enables an improved understanding for organizational structures, the relationships among components, and the potential domino effects of change. Specifically, how a major change of any organizational component can indirectly influence the output of other components within the organization.

Systems theory is relative to this study because it provides a lens to understanding that ineffective technology-enabled change can affect more than one business process and potentially the efficiency of the entire organization. Thus, the concept provides credibility and reason for appreciating factors of change relative to technology management, acceptance, and implementation. Systems' thinking has its roots in systems theory because it involves a generalized view of the same principles that could be applied to all objects (Palaima & Skarzˇauskiene, 2010). A system-thinking viewpoint is the practical application or tools grounded from theory and used to understand relationships, interpret patterns, and create find order within chaos (Palaima & Skarzˇauskiene, 2010, p. 333).

Systems thinking. Systems' thinking is a mindset that considers the relationships and interconnections among parts of a system. Systems thinking is an approach based on general systems theory (GST) theorized by Bertalanffy (1972). Systems theory is defined as a grouping of interrelated components combined into a whole (Banathy, 1992;

Bertalanffy, 1968; Kemp, 2006). Deming (as cited in Leon, 2008) maintained, "a system only exists when its components are interrelated in the pursuit of a common aim" (p. 15).

As an example and under these descriptions, a U.S. Air Force Wing structure can be considered a system (Kemp, 2006). For example, an AF Wing is composed of at least two groups or components such as the logistics group and the operations group. The logistics group is responsible for supply, transportation, and aircraft maintenance activities (broad sense), while the operations groups are responsible for activities including flying squadrons, pilots, scheduling. Although independent of each other, each group is dependent on the other to accomplish the common objective of the operational wing. Therefore, it can be understood that changes or negative effects in one group or component can potentially affect another. In other words, the ineffective use of technology can affect the logistics group's mission objective, to fix aircraft. These problems will in-turn affect the operation group's ability to fly aircraft into the battlefield.

In MRO organizations, systems thinking can help managers view the organization with a broader perspective relative to the interactions of people, processes, technology, structure, and external relationships. A holistic approach would allow managers the ability to analyze and identify multiple problems, rather than those of specific events. The developed insight will ultimately help managers to improve, solve, or troubleshoot several issues at a time throughout the organizational system.

A system's thinking approach is a beneficial tool that should be considered during strategic planning for IT systems. Its holistic management approach cannot only enable effective change within a single entity but across all interrelated components. A study

conducted by Palima (2009) compared the effect of systems thinking and leadership performance. Using 201 respondents working across manufacturing and retail, Palima (2009) found that systems thinking linked to higher leadership performance. A subsequent study conducted in 2010 revealed that the development of systems thinking competencies improved the efficiency of the organization (Palima, 2010).

In an effort to understand why this study is important, one must visualize through an example. The following research model is an actual instance of technology implementation that created chaos, ineffectiveness, and a cycle of mistakes that continue today as depicted in Chapter 1 and the motivation for the current research study.

Research Model

Technology-enabled change is rarely user friendly, especially when the change is a complete shift in business practice. The ability to transform an organizational culture from one paradigm to another requires the understanding of the complexities of the technology and the affect to business processes and users. In today's technology centered environment, most planners tasked with modernizing organizational processes appear to concentrate on process requirements, contractual language, reasonable costs, enhanced productivity, and short time-lines (Martin & Huq, 2007). Although important, these areas focus more on managerial responsibilities and fall short of addressing the socio-technical aspects of people and technology, which need to assimilate as one inclusive system (Mumford, 2006).

Too often, technology-enabled change neglects the human factor (Hornstein, 2008). This mind-set continues today and is evident by the ineffective and or fragmented

technology systems deployed and or shelved by government, public and private corporations, nongovernmental, and DOD organizations. A notable example of this mind-set builds this case study and includes implementation of a logistics information system within the DOD. In an effort to keep the specifics of the program and lead personnel anonymous the project in this example is titled Project X, with personnel names changed to protect identities.

Project X was designed to provide the capability to access, store, and manage more than 109,000 active TMs consisting of approximately 13.4 million pages in use within DOD installations today (Command X, Audit Agency, personal communications, Oct. 17, 2007). The system provided global TM management, distribution, electronic TM repository, and transactional activities between responsible managers and the TM librarians (TODOs) located throughout DOD installations within the U.S. and abroad.

In June 1999, Command X directed all users to cease the use of the G022 system and directed changeover to the Project X system (F. Airman, personal communication, Dec 10, 1999). However, only one month was allowed to complete the turnover and employ the new system (G. Airman, personal communication June, 14, 1999). After several months of significant implementation and data changeover issues, numerous communications from high ranking stakeholders were sent to the project's program manager (PM) expressing its poor performance citing, "lack of creditable fixes for the existing shortfalls" and "constant monitoring and workarounds to ensure performance" (H. Airman, personal communication, December 6, 1999). In April 2000, another communication to the PM expressed concern about the tedious processes, lack of

performance, and lack of capability in comparison to G022 system (I. Airman, personal communication April 14, 2000).

After more than 2 years of trying to make the system work the problems became so severe that it created work stoppages for some organizations. Work stoppages caused an absence of up-to-date technical data distribution to the aircraft MRO organizations. Up-to-date technical data is critical because outdated maintenance information jeopardizes the airworthiness of aircraft, support equipment, and the potential safety of the flight crew and maintenance personnel. In 2001, the project X software was revised, stabilized, and finally became usable (J. Papa, personal communication. 2001; L. Estep, personal communication April 27, 2001).

Effects of project X. The ineffective implementation of this technology effected users and stakeholders on many different levels. First, stakeholders developed a lack of buy-in, support, and confidence for a system implemented on short notice and plagued with usability issues (S. Teate, personal communication, February 19, 2013). Blanchard (2010) postulated that change is more effective when the people affected by the change are involved. Positive firm performance hinges on how technologies are implemented and managed (Hornstein, 2008). However, in Project X this change strategy was not employed. Second, implementation failure created negative perceptions among using organizations. This became apparent when system-to-system transactions could not be processed because receiving organizations resisted using the project X system. Additionally, stakeholders grew weary of the workarounds required to use the system and did not trust it regardless of the improvements (R. Bailey, personal communications, May

8, 2001). Third, negative stakeholder perceptions led to the proliferation of unilateral development and fielding of commercially procured TM management systems to support business processes poorly designed in project X (R. Conner, personal communication May 14, 2001).

In 2003, the affected MRO installations within the DOD halted the field use of project X as a result of costs, complexities, and management shortfalls. However, the repair centers (depot organizations) remained using the system to manage TM configuration, distribution, and printing for the MRO field organizations. In other words, it was removed from the retail side of the enterprise and remained only on the wholesale end where it could be closely managed.

The chaos of project X and its ineffective implementation was an accumulation of many programmatic and user identified issues. As a result, in February 2008 another system, Project Y was fielded to replace Project X for the MRO field organizations. The difference between both systems was significant because project Y not only provided improved functionalities; it provided new capabilities and new challenges, as well. One new capability was the ability to view electronic technical manuals via laptop computers (eTools). The system was designed to connect directly to a central information digital repository that pushes updates automatically to the eTools in near real-time. Accordingly, the new system enables maintenance personnel to use up-to-date electronic technical manuals at the point of use. This capability improves readiness and reduces safety risk of flight inherent in current legacy or paper enabled process or systems (personnel communications D. Guinaugh, 2007).

The DODs shift towards digitized maintenance practices was a major step towards moving into the 21st century (as cited in Schaven, 2007). However, now, the system required new technical skill sets, processes, and management activities that were never strategized as part of the implementation and employment strategy; thus, implementation became fragmented. As a result, the implementation of 21st century technology and digital processes became a *learn as you go* experience.

After more than a decade of attempts to field technology, less than 70% of the MRO maintenance community (S. Teate, personal communication, 2012) has effectively implemented the digital technology to view electronic technical manuals. As previously mentioned, corporate goals were set, expired, reestablished again, and never met. The inability of the MROs to fully realize the corporate goal is an indication of unsuccessful implementation strategies, which the researcher suggested do not consider the needs of users affected by the technology. The current study applied the knowledge gained from this narrative experience to design a robust l research question, what are the socio-technical factors that have inhibited the transition from a paper-based system to an electronic one.

Summary and Conclusions

The extensive literature review provided the foundation to understanding the research question, objectives, and goals of this research proposal. The literature was based on four essential concepts of IT-enabled change: organizational change management, change theory, technology acceptance models, and leadership's role in preparing an organization for organizational change. The review provided background

information on the socio-technical aspects of IT-enabled change based on culture, technology, theory, and various change management perspectives. In addition, the review examined various technology acceptance models and established change strategies. This chapter also discussed important factors to consider when transitioning an organization to a desired state and emphasized the importance of leadership's role in organizational change. Finally, it provided a real-life and ongoing example of more than a decade-long transition that demonstrated classic human issues relative to theory, change management, resistance, and technology acceptance grounded from the literature presented.

This study provides a step closer in an important movement towards improved best practices for technology-enabled change by focusing on the exploration of factors that influence adoption by end-users. By applying an integrated research framework and an exploratory qualitative methodology, this study contributes to a gap in the literature by recognizing user-defined factors critical to technology acceptance and integrating them within a change management philosophy that positively drives technology-enabled change. Chapter 3 includes the research method and the supporting aspects of the qualitative method of inquiry to answer the research question posed. Moreover, the chapter describes the sample population, data collection methods of inquiry, tools, and expected results.

Chapter 3: Research Method

This chapter includes the research design, concept, selection of a representative sample, data collection, and analysis approaches, and the expected results of the study. The research method selected for this study is a qualitative design, specifically an exploratory case study. The purpose of this study was to identify and explore the socio-technical factors that inhibit an effective transition from a paper-based TM system to an electronic-based system in an MRO maintenance organization.

Research Design and Rationale

Researchers use various types of research approaches to conduct studies. In quantitative approaches, the researcher seeks to answer hypotheses based on analysis of numerical data collected from tools such as surveys, questionnaires, or experiments that are scientific in nature (Creswell, 2009). Aliaga and Gunderson (2002) defined quantitative research as "explaining phenomena by collecting numerical data that are analyzed using mathematically based methods ([in statics], as cited in Muijs, 2004, p. 1).

For qualitative approaches, the researcher is the data collection instrument and compiles data from various collection techniques such as in-depth interviews, observations, or documentation that is descriptive in nature and collected from real-life settings (Patton, 2002). The strength in qualitative field research is its flexibility and "its depth in understanding" (Babbie, 2011, p. 348). The research method or design chosen depends on "the nature of the problem, issues being addressed, personal experience, and the audience for the study" (Creswell, 2009, p. 3).

This study used a qualitative research method of inquiry and was chosen instead of a quantitative method because the approach facilitates an in-depth and detailed study (Patton 2002). A qualitative approach is unconstrained, descriptive, and flexible to explore people's experiences, perspectives, and underlying issues within the setting under investigation (Babbie, 2011; Creswell, 2013; Frankfort-Nachmias & Nachmias, 2007). A key strength to qualitative research is that it allows an in-depth understanding by directly observing the phenomena under study (Babbie, 2011).

A quantitative method was not chosen because its data collection instruments are standardized and rigid by design. Thus, it cannot account for various perspectives and experiences of people missed when using instruments with predetermined categories (Patton, 2002). For example, in using a quantitative survey approach, the researcher can unquestionably conclude that 100 people voted for the president (closed-ended non descriptive data points). In contrast, a qualitative interview approach allows the researcher to determine why 100 people voted for the president "Qualitative researchers attempt to understand behavior and institutions by getting to know the persons involved and their values, rituals, symbols, beliefs, and emotions" (Frankfort-Nachmias & Nachmias, 2007, p. 257). Thus, a qualitative research method is the best-suited approach for the study, as it promises to provide a holistic and descriptive understanding of the problem in this investigation.

Creswell (2013) identified five qualitative strategies of inquiry popular to social and health sciences. Among them are narrative, phenomenology, ethnography, grounded

theory, and case study. A broad understanding of these strategies provides explanation to the approach of this study.

Qualitative Strategies Explored

Authors typically use a narrative strategy with a focus on stories told by individuals. Some examples include a biography, autobiography, and a life story (Creswell, 2013). Grounded theory is a strategy used to generate or discover theory. Theory is generated or grounded in the data collected from participants "developed by the interactions or processes through interrelating categories of information based on the data collected from individuals" (Creswell, 2013, p. 63). An ethnography study is focused on an entire ethnic group. This design is used when the researcher observes, explains, describes, and interprets the shared patterns, values, behaviors, beliefs, and language of a cultural sharing group (Creswell, 2013). A phenomenological study is an interpretation of phenomena based on lived experiences of several individuals. An example of this could be those who experienced Japan's tsunami of 2011. A case study is in-depth study/investigation that examines a program, event, activity, or process of one or more individuals (Creswell, 2013; Yin, 2013). Researchers collect descriptive information using various data collection procedures. Yin (2013) further explores specific types of case studies including explanatory and exploratory.

In considering how each of these might best answer the research question for this study, it was determined that the most appropriate among the approaches was the exploratory case study. A case study strategy was most appropriate because it enables an in-depth exploration of the phenomenon within its own context by providing the ability to

observe group behaviors and work processes within their operational environment (Babbie, 2011; Yin, 2013). Furthermore, of the various types of case studies an exploratory case study provides a platform to explore new or unexplained phenomenon, which has not been well documented previously (Yin, 2013).

The design chosen was intended to allow the researcher to gain a comprehensive, descriptive, and real-life understanding of phenomena (Yin, 2009; 2013). Finally, an exploratory case study design also is compatible with an FFA framework, providing appropriate bounds to the case (Yin, 2013). Thus, together, the exploratory case study methodology and FFA framework design is suitable to explore what MRO organization employees perceive as factors critical to the use, acceptance, and adoption of digital technology, and answer the following research question: What are the socio-technical factors that have inhibited the transition from a paper-based system to an electronic one?

In developing this exploratory case, the conceptual framework of the integrated change management and the FFA analysis (Lewin, 1951) was used to develop the bounds of the case. For the bounds of the case study, the study's questions, unit of analysis, and criteria for interpreting findings were clarified (Yin, 2013). This allowed for a time period, relevant geographic area, and the type of data to be collected to be identified. After presenting the research framework, the bounds of this case study are further outlined in the remainder of Chapter 3.

Research Framework

This study employed an integrated change management and force field analysis (Lewin, 1951) framework to exploit and identify critical socio-technical factors that

influence the transition to a paperless paradigm. The method was formulated to provide focus on the factors of user adoption, acceptance, and effective implementation as perceived by those who use and manage it. The ultimate goal of this study will be to set the stage for future application of strategies, action plans, and potential generalization across a broader aircraft maintenance population.

For this study, internal users and managers from one aircraft MRO organization participants shared their perceptions of the organization's digital transition state of affairs, as well as their experiences during the transition. Observations provide a real-life understanding of the work environment, daily work practices, and potential issues associated with the use of the technology (Yin, 2009). Individual interviews were conducted to conceptualize the perceived value of the technology (Davis, 1989). In an effort to understand the most influential factors of technology acceptance, a follow-up questionnaire was used for participants to rate the most important and most implementable factors. To collect the various data points using interviews, observation, field notes, and follow-up questionnaires, an exploratory qualitative case study design was most appropriate for investigating this problem, as justified previously.

Benefits of a qualitative design include being descriptive, telling a story and not being limited to specific data collection instruments; the researcher is the instrument (Patton, 2002). The research method permitted the researcher to study and observe participant's attitudes and behaviors under natural settings (Babbie, 2011). The strength of this method is its ability to collect real-life data based on human interaction, behavior,

observation, and by experiencing the same realities that people experience within their own environment (Babbie, 2011; Patton 2002).

Specifically, the research question was best answered by applying an exploratory case study design, using the integrated change management and force field analysis (Lewin, 1951) framework. An explanatory case study was used because of its suitability for investigating distinct or specific phenomena that has not previously been well documented (Yin, 2013). In the next section, the role of the researcher as a primary research tool is presented.

Role of the Researcher

My role in the study was mainly to observe and encourage participants to give open and honest responses. Moreover, as a facilitator in providing open-ended interview questions, this role includes the responsibility to document accurate data for analysis. In qualitative research, the researcher's role is to be the research instrument (Patton 2002). Applying this approach, the researcher collects descriptive data and interprets that data based on what he or she sees, hears, and understands (Creswell, 2013). Consequently, "the researcher must focus on learning the meaning that participants hold about a problem or issue, not the meaning of what the researcher brings to the research" (Creswell, 2009, p. 175). In an effort to mitigate potential bias, it is important to identify personal connections, individual viewpoints, and professional roles relative to the phenomena and organization under investigation and control for these potential biases appropriately.

The following is a description of my role and identification and control of any potential bias for this study. Employed in an MRO organization, I oversee the development and conversion of aircraft technical manuals into a digital format in support of thirteen MRO organizations and several weapons systems within the DOD. As lead program manager and member of various integrated process teams, I am responsible for overseeing the development of several DOD technology initiatives. I am also involved in authoring software application requirements, developing policy, overseeing the deployment, purchasing and implementing of eTool technology, and tracking its usage within my span of control. This level of involvement may lead to some bias. Specifically, I acknowledge an inherent belief in the value of implementing fully digitized processes. Moreover, in eliminating paper business practices that impede intended technology efficiencies, contribute to process redundancies, program complexities and unnecessary spending of taxpayer resources. Thus, one potential bias is the assumption that paperless technologies can be efficiently used to save time and money, when implemented using the appropriate change strategies to maximize compliance and minimize resistance. It is important to emphasize that this bias is supported in the literature review of this study as a validated reality. There is a further supported emphasis on the unnecessary effect of breakdown in implementation, and the benefits of shifting into a fully digital environment.

While there are some limitations due to potential bias, there are also strengths developed from my personal experience and involvement in this field. First, I have a firsthand understanding of the phenomena from an external perspective. Second, with

more than 26 years of aircraft maintenance experience, I can relate effectively to the experiences and viewpoints of the participants. Finally, I am familiar with the aircraft MRO culture, organizational structure, and leadership protocol. Therefore, I am able to gain access to data needed in an environment that is generally difficult to study. An argument can be made that the strengths from personal knowledge and experience outweigh any potential limitations. Thus, to ensure the accuracy of data collection and to mitigate potential bias issues, I plan on performing the following steps: member checking, crosschecking, and triangulation as further explained in future sections.

Methodology

For this exploratory case study, the unit of analysis was one DOD maintenance organization, which was purposefully selected based on pre-established criteria, to participate in the pilot study and the main research study. Further, participants were purposefully selected within the organization based on their connection/experience with the phenomena and their position within the organization. Multiple data events were employed to ensure the fullest and most accurate investigation. The next subsections present the sample size, the sampling technique and the other data collection events used in the methodology for this exploratory case study.

Sample size. One bound of a case study is the sample size, and recruitment strategy. For this study, the sample solicited included a total of 23 participants, 20 for the main study and 3 for the pilot (Table 1). According to Creswell (2013), qualitative research sample sizes are typically smaller than quantitative sampling because a qualitative study compiles data from sources central to the purpose of the research. The

rationale for sample size is based on purpose. For example, in quantitative sampling, the objective is to gather data from a large enough population in order to generalize (Patton, 2002). In contrast, the purpose of qualitative sampling is to provide participants who have the most potential to provide the information needed in a rich, in-depth, and comprehensive manner (Yin, 2013). A limitation of the study influenced the sample size, as mentioned; aircraft maintainers and operators are constantly on call and work on high operational temples. As only a portion of the study (main) was conducted during work hours, access to personnel was restricted to no more than 20 participants or until saturation occurred. Therefore, participants for the main study, were limited by number prior to implementation (see Appendix A). However, any concern about this sample limitation was mitigated during data collection as saturation was reached after reaching 13 participants as explained in Chapter 4.

Further, based on prior qualitative research Creswell (2009) recommended approximately six to eight interviewees as sufficient for case study design, arguing that this number should be more than adequate in understanding the desired phenomena and answering the research question. Patton (2002) proposed that there are no rules on sizes in qualitative studies and that sample sizes are based on "judgment, purpose of the study and stakeholder interests" (p. 246). Therefore, for the purpose of this study, 20 participants were sufficient to meet needs and match stakeholder interests. Patton also suggested that as the study unfolds and potential value added information emerges then the sample size may change. Thus, the qualitative design is flexible to significant value

added data or inadequacies that may change from the original sampling approach (Patton, 2002).

Table 1

Anticipated Sample Population for Research

Duty Positions	Type of Inquiry	# of Participants	Type of Study	# of Participants
Grp Cmdr.	PS	1	Main	1
TODO (Program Mgr.) & Alt.	PS	1	Main	2
Maintenance Mechanic	PS	1	Main	17
	Total	3		20

Note: Grp Cmdr. = Group Commander (or equivalent); PS =Pilot Study; Technical Order Distribution Officer = TODO

Participant Selection Logic

The sample population for this research included two maintenance organizations, Flying Training Wing X (FTW X) and staff members from the headquarters X (HQ X). There were 20 participants solicited for the main study and three participants for the pilot study. Three members of the HQ X staff were solicited to pilot test the interview questions/guide and questionnaire.

Purposeful sampling. A purposeful sampling approach was used to capture viewpoints from specific participants in selected organizational positions. An in-depth understanding from the various viewpoints ensured that all perspectives were adequately represented in the investigation (Patton, 2002). As this is a case study, purposeful sampling has been established as appropriate for case study designs (Patton, 2002). Participants of the main study were selected based on their specific positions within the

FTW X organization. These positions include, one group commander or equivalent, two technical manual distribution officers (TODO/program managers), and 17 maintainers (technology users). The total anticipated number of participants for the main study was estimated to be as much as 20. The number solicited within each position differed because there are only a specific number of personnel assigned to these key positions in the MRO organization. Purposeful sampling can create information rich pool of participants directly associated with the phenomena under investigation (Patton, 2002). As previously mentioned, participants were purposefully selected because of their position in the organization and their connection with the phenomena. Following is a review of the positions represents across participants.

Senior managers. Senior managers were leaders whose position resided at the top level of the MRO management structure. For a DOD organization, these leaders are equivalent to a full-bird Colonel in the military or civilian equivalent who typically oversees hundreds of personnel. The senior leader was specifically chosen because of their responsibility to plan, oversee, communicate, implement, and fund the digital transition to a paperless maintenance environment.

TODO. The TODO ensures aircraft maintenance technical manuals and libraries are accurate, up-to-date, and available for use (AF TO 00-5-1). The TODO manages all aspects of the technical manual program to include the eTools used for viewing the data. The TODO was purposefully selected because of the direct relationship with the shift from paper to digital processes in both program redesign and user aspects.

Aircraft maintenance mechanics. Aircraft mechanics were purposefully chosen because of their foremost importance as technology users. This was because for most all DOD installations, the aircraft maintenance workforces were the primary recipients of the technology-enabled change. Therefore, the mechanics perceptions, attitudes, and viewpoints on how the shift took place were integral to the findings of this study.

Snowball sampling. Some populations may be challenging to sample therefore, a snowball sampling approach may also be used if the purposeful sampling approach does not obtain the appropriate number of participants or sample size. Snowball sampling is a technique when the researcher asks the few participants in the study to provide referrals of other members in that population from their network of colleagues (Schonlau & Liebau, 2012). This type of approach would have been used as a last resort method; however, it was not necessary for this study.

Instrumentation

For this research study both an interview guide and a follow-up survey instrument were employed. The *interview guide* provided structure for to ensure a systematic protocol was in place for the interview sessions. The guide contained a list of procedural activities to include, intro, purpose, confidentially briefing, consent signing, data collection and member checking process briefing. It also contained the written interview questions (see Appendix B). The guide was used to steer the conversation, maintain consistency across all interview sessions, and helped in controlling the line of questioning (Rubin & Rubin, 2012).

A follow-up questionnaire was distributed to participants to provide ratings for key factors captured during the interview sessions. This instrument developed the foundation of the force field analysis framework that enabled final analysis of the findings and the constructs for building the action plan. Another researcher developed the questionnaire format. However, written permission was acquired to use the questionnaire as a template for the current research study (see Appendix C). Before implementing the main study, a pilot study was conducted to ensure the instruments and methods were trustworthy, free of bias, appropriate for the current population, and understandable at the proposed reading level.

Pilot Study

To ensure the interview questions, instructions, and questionnaires are suitable, three staff members from headquarters X were recruited to perform an expert review on the set of instruments and the methodology. It is important that the instruments used in the main study are reliable and valid because usefulness is crucial to analyzing the research findings (Guindon et al., 2010). The purposefully selected members had extensive firsthand experience with technical order management, senior level commander responsibilities, and eTool technology usage (Burton & Mazerolle, 2011). The timeframe to evaluate validity and reliability took only a few days. All members were recruited as volunteers (see Appendix D). Members signed consent forms and were treated with the same dignity, respect, and confidentiality as the onsite participants in the main study (see Appendix E).

Procedures for Recruitment, Participation, and Data Collection

A major strength in a case study research is the opportunity to use multiple sources of evidence. Sources commonly used in case studies include documentation, archival records, interviews, direct observation, and physical artifacts (Yin, 2009; 2013). This study incorporated five types of data sources: individual interviews, observations, follow-up interviews (post observation-interviews), documentation, and questionnaires. When used in the correct combination, multiple sources can be complementary to each other and allow triangulation of data to validate findings (Yin, 2009; 2013). To maintain the integrity of the non-AF sanctioned research event, individual interviews, post observation-interviews, and questionnaires took place during off work hours.

Initial contact for solicitation of participants began when a letter of cooperation was signed by the organization. Afterwards, participant contact information was obtained by an internal email request for participation (see Appendix F). This ensured that only the particular population was targeted. The following are the sequential data collection events that occurred for this study.

Individual interviews. Interviews are effective methods of inquiry that allow the researcher to understand beyond external behaviors (Patton, 2002). This also allowed me to observe nonverbal messages that can assist the researcher in evaluating whether captured information is trustworthy (Yin, 2013). Semistructured interviews were used to explore employee perceptions, attitudes, and viewpoints. This method was preferred because it is fluid and allowed for flexibility in questioning related to spontaneous information as it arose (Yin, 2009).

Participants were recruited via email with an attached open invitation letter to include the letter of cooperation signed by the organizational commander. Participants interested in contributing replied back for scheduling interviews. Initial open-ended interview questions are outlined in Appendix B; however, probing questions were asked during conversation.

An interview guide ensured a structured interview process approach. The guide ensured that protocols were methodically followed. The guide also incorporated a list of resources needed during and prior to conducting the interviews. Moreover, the guide ensured the primary focus on general topics of inquiry, encouraged participants in providing details, aided in refining follow-up questions, and assisted in controlling the line of questioning (Rubin & Rubin, 2012).

Observations. Observations are commonly used in case study research and can provide unbiased information of the research phenomena (Hancock & Algozzine, 2011). Observations were conducted to get a real-life or firsthand look at the environment and evaluate the way the maintainers were using the technology (Creswell, 2013). Observations took place during maintenance activities and within the maintenance hangar complex. This method of inquiry enabled the researcher to understand the dynamics of the organization under the context of its actual setting, assisting with identification of factors or problems influencing technology adoption (Yin, 2009). Observing the people and the technology in use, allowed for examination of various dimensions of technology acceptance and implementation issues (see Appendix G). For example, if the eTools (laptop computers) are obsolete and the electronic technical data is slow in displaying

data, this could be identified as a factor driving resistive behaviors among users. On the other hand, if the eTools are new and up-to-date, yet, the users are demonstrating difficulties, then transition may be hampered as a result of computer skill-sets or training shortfalls.

Additional observation points included evaluating how the technology architecture is set-up and whether access to the data was user friendly. For example, if one of the maintenance shops required access to only 100 electronic TMs but must sort through 5000, this could be observed as a factor supporting technology resistance or rejection. Yin (2009) stated that field observations could be an invaluable tool for understanding the actual issues associated with technology use. Although observations provided important insight to a real live work environment, there are potential risks associated to data accuracy when examining individual behaviors (Creswell, 2007).

Observations have the potential of being deceptive or biased. Observations can be deceptive when the people being observed become nervous or intimidated, which can lead to changing behaviors or procedures (Creswell, 2007). Therefore, it is important that the researcher maintains a low profile to mitigate distractions and the possibility of events from being manipulated (Yin, 2009; 2013). Sometimes observers too close to the phenomena under investigation may not look at the situation with complete objectivity. This can happen when the researcher interprets events during observations rather than waiting for a complete analysis (Stake, 1995). Therefore, for this study, I did not interact with participants and remained as inconspicuous as possible except during initial and completion periods of the session.

The purpose for performing observation was to gain insight into unusual aspects of the environment, understand direct participant experience, and gain insights to motives or behaviors (Yin, 2009). Furthermore, it allows the researcher to uncover any potential gaps between management guidelines and user interpretations. In an effort to help further explain the dimensions of the observations for this research study, follow-up interviews were conducted as required.

Follow-up interviews. Follow-up interviews, post-observation interviews, were conducted to answer possible questions generated as a result of the activities observed during the observation sessions. Menjvar (2000) suggested that observations followed by interviews are a useful technique in exposing more complex and social processes (as cited in Barbie, 2011). The purpose of these interviews was to ask questions and clarify description and interpretation about what was observed (Stake, 1995). Questions were determined and captured as noteworthy factors were disclosed and identified shortly after the observation sessions were completed.

Follow-up interviews were conducted with the same participants being observed in the previous data collection step and shortly after the observation period, as it was determined necessary. Follow-up interviews assisted with controlling for any potential bias in researcher interpretation by clarifying the observed paths of the participants and acquiring detail, depth, and understanding of observed behaviors (Yin, 2009). Afterwards, member checking ensured the accuracy of the collected data by confirming interpretations by asking the participant to validate or challenge the interpretation made. Member checking was conducted for all interviews and observations events detailed in

Chapter 3. Another method of inquiry used to add credibility to this case study was a review of documentation.

Documentation. Frankfort-Nachmias and Nachmias (2007) suggested that the review of documentation "removes the researcher from any direct contact with the interaction events of behavior being investigated" (p. 287). Moreover, the approach helps prevent the researcher from influencing conditions under which the data is collected; thus, adding strength to the overall findings. Documentation provides a pathway into understanding potential variables that may not be directly observable (Patton, 2002).

An examination of the program's internal policy and procedures, the unit operating instructions, and any other information helped in identifying potential issues from the management's perspective (see Chapter 4). Documentation was accessible from the organization's Quality Assurance office. The Quality Assurance office which provided the required documentation for review is responsible to evaluate, inspect, oversee, and enforce the quality of all maintenance programs and activities outlined in applicable MRO guidance. After securing the documentation, I examined it for potential conflicts between internal policy and procedures, the interpretation of guidelines between staff members and workers, and potential training shortfalls. The use of documentation helped to corroborate other sources of information, assisted in triangulation and crosschecking, and further confirmed the study's findings (Yin, 2009). The use of documentation helped contribute to understanding the program on a holistic level that suggested additional research and questioning activities (Yin, 2009). The documentation protocol is in Appendix H.

Questionnaire. To complete the data collection process, a questionnaire was distributed to participants after data was collected, aggregated, and factors were identified. The information compiled was based on the FFA framework discussed earlier in this chapter. The FFA questionnaire was designed to capture factors that participants perceived as barriers in influencing technology implementation and adoption. Moreover, it included a rating scheme that asked participants to rate identified factors by level of influence or importance and its perceived level of implementation. The questionnaire clarified that factors perceived as implementable should be considered for the development of strategies, outcomes, and recommendations. Finally, the developed questionnaire requested that participants identify three recommendations they perceived would improve technology adoption and organizational efficiency. After the questionnaire was completed, the data was analyzed and findings presented in Chapter 4.

The information gained from this FFA questionnaire facilitated three important pieces of this research. First, it helped to identify important factors to technology-enabled change as perceived by the internal users. Second, results provided an opportunity to further validate the study by triangulating and comparing the data from the other data sources. Third, data assisted in identifying factors that are potentially implementable in order to assist in the development of a future action plans and strategy to improve overall technology implementation. Finally, the FFA set the stage for future research by providing lessons learned and critical factors, which can subsequently be validated for potential transferability across a larger DOD population. Following is an overview of the data collection process, step-by-step. Figure 1 represents the order and characteristics of

the data collection process, methods of inquiry and data validating processes that were conducted for this qualitative case study.

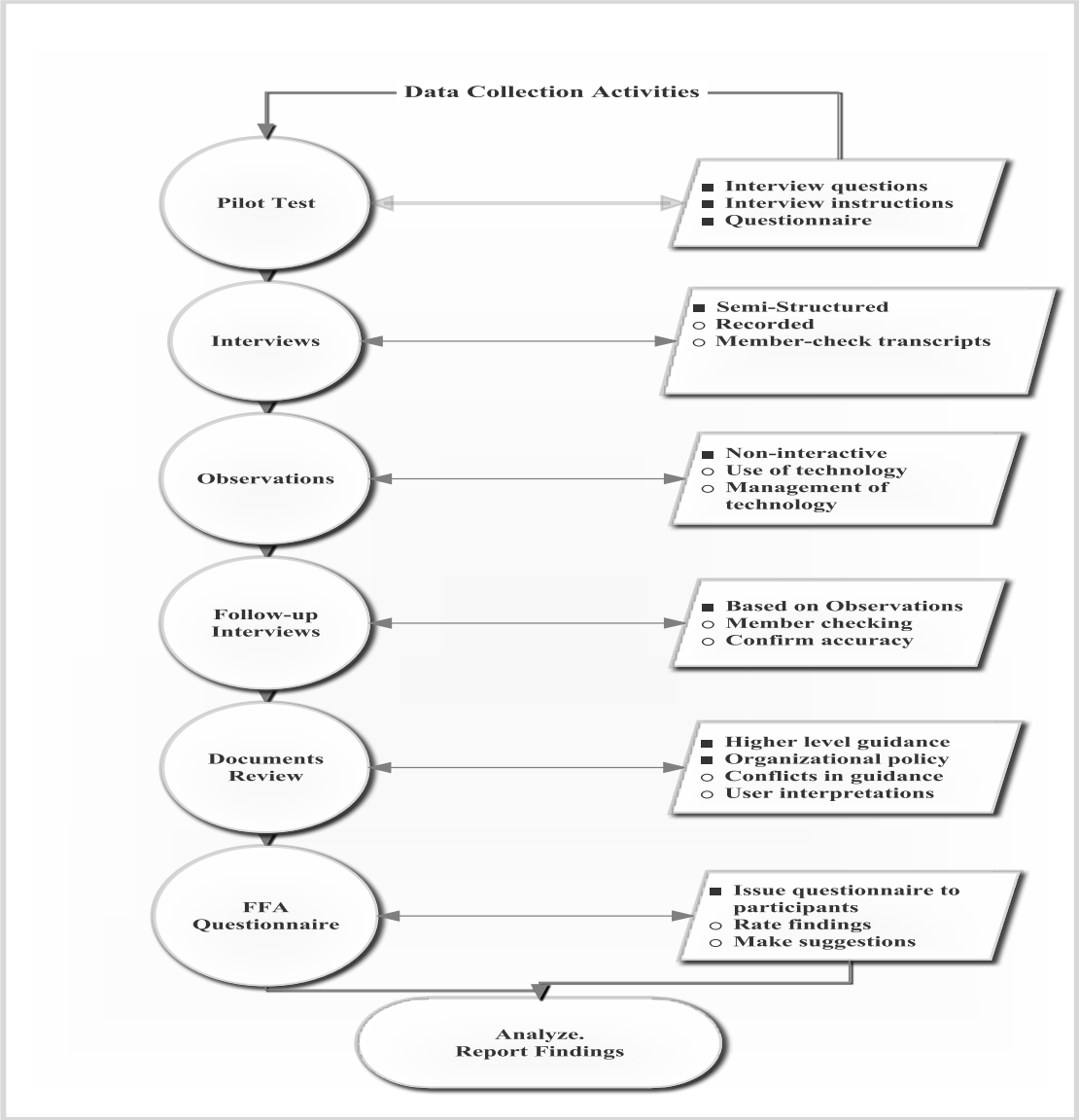

Figure 1. Step by step exploration of the data collection activities and characteristics.

Data Analysis Plan

Individual interviews and observation data, as described above, were prepared by transcribing recordings and field observation notes into text. The text were analyzed, sorted, and organized into factors. Factors were determined by frequency and further sorted into emerging patterns and themes (Patton, 2002). Coding is the act of organizing information into chunks or pieces of data. Hand coding, as described in the next section was used to identify the themes and patterns. Upon sorting and identification during the hand coding, data were labeled based on descriptive information and analyzed for meanings, ideas, and mapping (Rubin & Rubin, 2012).

Following the hand coding, analysis and representation of the data were facilitated using the NVivo10 computer software package. NVivo10 is a tool built to help researchers analyze, organize, and structure large chunks of data. NVivo10 also assisted with providing a capability to visualize and identify evidence, trends, themes, and relationships between factors. While, NVivo10 was applied to sorting, storing, and exploring data, the initial and primary method for analyzing data included hand coding.

Coding Data

Once data were collected, transcribed, and sorted, the coding consisted of breaking down and grouping the compiled transcribed text according to characteristics (Rubin & Rubin, 2012). This process was like developing a file system, which was divided by specific and descriptive information individually labeled on the files. The process used is often called open coding and includes the identification stage of the process (Babbie, 2011). As patterns emerged during hand coding, the data was

inductively interpreted based on inferences, consistent words, and repeating phrases (Auerbach & Silverstein, 2003). For example, if terms related to a lack of understanding and then were repeated during the interviews, then this construct might be labeled or coded as a factor labeled 'training deficiencies.' This process consisted of repeatedly reviewing core concepts, which is also called axial coding (Babbie, 2011). According to Babbie axial coding is completed using the results of open coding. The coding process required the researcher to refine, consolidate, delete, regroup, or rename the codes until themes have been fully consolidated.

NVivo10 software was used to validate the coding process and assist with storing the data. Specifically, NVivo10 software identified repeated words throughout the text and suggested relationships between the factors. This process assisted in confirming findings developed during hand coding. In addition, the software was used to apply appropriate labels and group the data into categories for the purpose of storing and developing visual representations of the findings. After data entry and sorting data, I reviewed the NVivo10 results and made adjustments as appropriate. For additional confirmation and to reduce potential bias, an independent reviewer crosschecked my results to ensure the accuracy of the data.

Issues of Trustworthiness

For this study, I took several steps to ensure collected data was scrutinized for credibility, conformability, transferability, and dependability. This helped to ensure that the results generated were valid, believable, and sound. In addition, all steps were taken

to make certain that the information collected from the participants were maintained with the strictest privacy and control procedures available.

Credibility

Member checking. Member checking was performed to ensure all interview information was accurately interpreted and captured. Member checking occurs when the researcher provides participants the opportunity to review, confirm, clarify, and comment on the reports or findings of interview data to verify the content (Creswell, 2013). The goal with member checking was to mitigate and eliminate misinterpretations and ensure the accuracy of the refined report based on participant agreement.

For the interview event, member checking was accomplished by sending transcripts to each participant to confirm the accuracy of the captured data. Participants reviewed transcribed data and made comments for correction or adjustment as necessary. For observations, member checking was simultaneously conducted with the follow-up interviews, when appropriate. This allowed me to ask potential questions formulated during the observations, verify what was observed, clarify assumptions, and ultimately to avoid bias.

Crosschecking. Crosschecking is a review of the data by more than one person to verify agreement in definitions, terms, and analysis (Creswell, 2013). An independent reviewer assisted in crosschecking the following: (a) review of the transcripts was accomplished to identify and correct obvious mistakes, (b) review of themes included an agreement that factors were well defined and accurate, (c) crosschecking the established codes and affirming that more than one person agrees on codes for the same transcript

text (Creswell, 2013). The application of cross-checking in this case provided an outside reviewer without the experiences of the researcher as a measure of rigor and control for the data analysis. The application of cross checking significantly reduced the chances for personal or interpretation bias during the development of themes and patterns. A final method of confirmation for results was used for the current study by comparing the data across multiple data sources. This method is triangulation.

Triangulation. This study included multiple forms of data sources encompassing observations, documentation, interviews, and questionnaires. Triangulation of data sources provided application of rigor in evaluating whether similar findings were confirmed across sources. Similar results between at least two of the data sources for the same question was a testament to the validity or confirmability of findings, strengthening the final argument. Patton (2002) proposed that one of the major purposes of using multiple data sources for qualitative research is to balance the study so that a weakness in one source can be compensated by the strength of another.

Transferability

Transferability refers to the degree to which the results of one study can be transferred to other settings (Lincoln & Guba, 1985). Currently, nearly all MRO organizations within the DOD, stateside and abroad with flying missions are transitioning to a digitized aircraft maintenance concept. The current study was a 1-month snap-shot of a single organization experiencing this transition. Stake (1995) postulated that a single case might not be a strong basis for transferability. However, the potential for transfer in this unique study is conceivable because the sample used for this study is representative

of most MRO organizations with flying missions. Unlike many other institutions, U.S. MRO organizations within the DOD are designed, operated, and managed using a similar culture and organizational structure. A significant attribute of the structure is the similarity across various points. The assumption is based on similarities in attributes such as organizational maintenance, structure, leadership hierarchy, maintenance philosophies of management (Command X, 2009), maintenance duty positions (Command X, 2009), standardized eTool technology, software application used with eTools (Command X, 2012), AF guidelines and directives, and standardized system architectures (Command X 2011, 2009). While research indicates this singular snap shot is not transferable (Creswell, 2007), in this particular case it can be argued that there is a stronger likelihood that the sample is transferable to other organizations because of the similarities and standardized nature of the DOD agencies, as noted.

Dependability and Confirmability

As explained previously, dependability is established through the process of data triangulation. Triangulation, of data sources in the current study helped to verify the findings and improve the dependability of the results. Further, to ensure objectivity, independent reviewer crosschecked the process by confirming results and challenging any assumptions as part of the triangulated data sources analysis.

In qualitative research, confirmability refers to the accuracy or truth expressed through the selected methodology during which the results of the study are collaborated by others (Given, 2008). Confirmability ensures that the researcher understands the meaning of the data given by the perspectives of the research participants. The use of an

independent reviewer to cross check the coding processes, assisted in establishing rigor and confirmed that the data was consistent with my interpretation. This process for ensuring dependability and confirmability contributes to the quality and rigor of the case study (Yin, 2013).

Ethical Procedures

Privacy protection and IRB. Due to the sensitive nature of the DOD population, privacy of research participants was carefully monitored and a priority for all participants. Before data collection, the Institutional Review Board (IRB) reviewed all prepared tools and instruments and provided official approval to conduct research approval (#08-12-14-0127632). The purpose of the IRB is to "assure that the institution conducts only research in which potential benefits outweigh the potential risk" (Walden University, 2012, p. 3). The IRB ensured that the privacy and interests of human participants were protected and in compliance with university's ethical standards. Privacy standards were based on minimizing risks to participants, including protection of participant rights and workplace.

Organizational approval process. Although, this study was not an official AF sanctioned event, AF officials within the researcher's chain of command took part in the approval process to obtain authority to conduct the study. This was accomplished through an established internal working group called the Education Integration Forum (EIF). The purpose of the EIF is to exploit the intellectual capital from Headquarters Air Education and Training Command's (A4/7) personnel pursuing advanced degrees. The goal of the EIF is to explore relevant academic disciplines, knowledge, concepts, and principals to

determine whether this knowledge can potentially be used to improve the organization's mission as a whole. Noteworthy ideas emerging from this forum are vetted through executive leaders and evaluated for value. If approved by the executive group, the chairperson or executive manager will provide authority to conduct the study. Students gaining approval will be given support and resources within reason and availability (see Appendix I).

This forum was a critical part of the process for instituting a DOD study, as to underscore the importance of this study for MROs experiencing the change phenomena. It is important to note that participants were not coerced or bribed into volunteering. The described forum simply achieves leadership buy-in to conduct the study. Final approval came from the MRO leadership, and the participants solicited at the organizations understood their rights as voluntary participants. All participants were reminded verbally and in writing that their participation was voluntary and that they could quit at any time.

Research oversight and compliance division. The purpose of the Research Oversight and Compliance Division is to ensure the protection of human subjects and adherence to ethical standards in accordance with the authority in DODD 321602. Thus, after IRB approval, the proposal was assessed against AF Instruction, AFI 38-501 and DODD 321602 and approved by the Research Oversight and Compliance Division within the DOD, approval #FSG20140028H (Appendix J).

Permissions. Research participants were recruited using an open invitation letter and letter of consent for interview/observation and pilot study forms (see Appendix A, C, D, E). The invitation letter provided the background and why the study is needed and the

consent form outlined the goals, purpose, risks, and benefits among other information. The consent form also informed participants of their right to withdraw at any time and that participation is completely voluntary. Additionally, a letter of cooperation was sent to the organization to ensure authorized on-site access and solicitation of its organizational employees

Treatment of participants. Care was taken to ensure all research participants were treated with respect and dignity. The interview, observation, and data analysis processes were conducted in a way to ensure all information provided by participants was kept confidential and under the strictest control. I accomplished this by maintaining self-devised anonymity and confidentiality protocols.

To ensure anonymity and participant confidentiality, I did not use any personal information for any purpose outside of this project. To mitigate risk and ensure anonymity, all participants were assigned unique numerical identifiers. Personal identifiers have been deleted from all personal correspondence. Confidentially of personal information is critical to both the participants and validity of the research data. Therefore, all participant correspondence will remain secured within a password-protected personal computer and maintained securely according to IRB protocols.

Treatment of data. Data collected during research events consisted of a mixture of both electronic and paper formats. The format depended on the specific activity and its purpose. For example, observation notes were taken by hand and maintained in a distinctive folder marked *private, do not open*. During use, this folder was kept in the researcher's possession at all times. However, when not in physical possession, the

information was secured in a locked file cabinet on site or in a safe at the researcher's home. Handwritten data was transcribed into MS Word and maintained in a password protected PC or laptop accessible only by me. All physical/electronic media to include recordings, paper notes, consent forms, participants list, raw data, and flash drives were secured in a locked cabinet at the researcher's home. Once the information is compiled and completed, it was be aggregated into the final report and kept in a personal hard drive in a safe for 5 years as required by the university.

Data disposal. Data was de-identified, secured, password protected and stored on a USB flash drive only accessible by the primary researcher. All paper documents or audio recordings will be kept in a locked cabinet for 5 years from the date of the final dissertation approval. After 5 years all paper documents will be shredded, audio recordings will be erased, and all electronic data will be wiped clean from the hard drive.

Summary

Chapter 3 includes discussion of the research design, concept, and research question for this study. For research data, this chapter included details of the method of inquiry, data collection, method of analysis and the pilot study. Furthermore, the chapter outlined the measures that were used to validate the trustworthiness of the research data and the steps that will be taken to ensure confidentiality and the ethical treatment of the participants. The next chapter presents the results of the current study.

Chapter 4: Results

This chapter includes a comprehensive review of results of this study. A force field analysis was the primary framework used in this exploratory case study. Multiple methods of data inquiry were used to explore the social-technical factors that influenced the degree of transition and technology-enabled change within one MRO organization. The results in this study answer the following research question:

> What are the socio-technical factors that have inhibited the transition from a paper-based system to an electronic-based system in MRO organizations?

This chapter includes a detailed description of the data collection and analysis processes used for this study. It is organized in the order of events and begins with a description of the pilot. The subsections of this chapter incorporate an explanation of results for participants, measurements, coding process, thematic analysis, and general interpretation.

Pilot Study

A pilot study was conducted to test the interview guide and protocol, interview questions for bias, and the questionnaire for internal clarity. The pilot study provided the opportunity to test and operationalize the data collection and analysis procedure planned for the main study (e.g., coding, interviews, interview guide, and questionnaire). The participants included three staff members from HQ X specifically selected for their many years of field and management experience as Group commander, TODO, and aircraft mechanic.

Interviews were conducted smoothly requiring no change in the interview guide or questions. However, the pilot study interviews revealed the importance of using examples, phrasing questions, and better probing techniques. The interviews were recorded and professionally transcribed into text. During member checking, each participant was sent a copy of their transcript to add, delete, or make corrections as needed. All responses were returned, no information needed to be added or change.

The interview transcripts were hand coded and a factor analysis was performed to identify important themes, frequency of terms, and to also reduce the number of variations of the same factors. After identification, factors were annotated into the questionnaire, which the pilot participants then ranked by level of importance and ease of implementation. Participants also provided feedback on the clarity of the instructions and understandability of the questions. The questionnaire served two important purposes in the pilot study. First, it documented whether the design of the instrument had internal clarity and confirmability. Second, it provided an opportunity to practice, fine-tune, and organize the coding and questionnaire process for the main study. Only slight typographic changes were made to the questionnaire. The above processes were concluded and confirmed by all pilot study participants with no major changes made to the instruments. The data captured in the pilot was not used as part of the main study.

Research Setting

The conditions in MRO where the study took place were ideal. The MRO was located within an aircraft runway and several aircraft hangars of the DOD installation. However, for this study, I worked out of only two hanger facilities. Each hangar had

controlled access however, supervisors and security personnel were informed of the researcher's pre-authorization to gain entry and make contact with personnel. All planned volunteers participated; however, a few had to be rescheduled due to their unforeseen workload or unexpected appointments. This had no undue influence on the participant's ability to contribute or affected the results. Participants were rescheduled and data collection activities were accomplished without further delays or issues. Interviews were conducted privately in offices away from the workforce but within the maintenance complex. The days of data collection appeared to be normal and business as usual. There were no indications of any adverse conditions such as lack of resources or other external constraints that would influence the environment or the participants in the research.

Demographics

The demographics for this study were typical of that of any DOD civil service maintenance organization. Volunteers included 12 men and 1 woman; eight were over the age of 50 and the remaining ages ranged between 20-50 years old. Twelve of the 13 participants attended some college or attained college degrees and only one participant completed high school only. Most all participants had military backgrounds such as, prior active duty service or retired from the Air Force. As for experience, 11 individuals reported over 15 years, one reported 10-15 years, and one reported up to 5 years of aircraft maintenance experience in the field. Although 20 volunteers were originally identified for this study, only 13 individuals participated. This was because after 13 interview events, participants were no longer providing any new information of value (Saumure & Given, 2008); thus, data saturation occurred after reaching 13 participants.

Data Collection

The interviews were conducted, recorded, transcribed, coded, and analyzed during November and December of 2014. The interview questions were semistructured by design and read from an interview guide to ensure consistency across all participants. The data collection process is outlined in the remainder of this section. First, transcripts from 13 interviews were analyzed to identify factors that influenced the transition from a paper to a paperless process. Second, noninteractive observations were completed on four aircraft maintainers (technology users) to note possible technology acceptance issues such as, equipment quality, understanding, or computer user competences. Third, organizational policy and higher headquarters documentation was reviewed to understand and determine whether interpretations or communication gaps existed within the workforce. As final part of the data collection, a questionnaire was administered to all participants and rated for further validation and analysis.

Interviews

The interviews were conducted based on the works suggested by Yin (2009; 2013). Participants were initially contacted using a group email address that allowed direct contact to the entire maintenance population. An open invitation letter and a signed letter of cooperation from the Director of Maintenance were attached. Interviews took place at scheduled times on the worksite and in unoccupied offices. Although, 20 participants were initially identified to participate in the main study, only 13 were needed. This was because data saturation occurred before the anticipated participant sample was reached. Saturation occurs when no new information of value is being

collected (Saumure & Given, 2008). The results of the interviews are outlined in the following data analysis section.

Observations

Observations were conducted within two aircraft hangars. These aircraft hangars had at least six aircraft parked for general maintenance inspections. This location was ideal because it allowed a complete look at the maintenance facility, working environment, and conditions, eTool equipment, and the workforce in action. Observations were conducted on four of the 13 maintenance participants interviewed. This was because there was no value in conducting technology use observations on all participants especially, for those who appeared confident with the equipment. Conducting observations helped better understand uncommon aspects of the maintenance environment and provided added insight to external issues that influenced the technology transition (Creswell, 2013). I observed the following in the maintenance hangar:

1. There were three different models of eTool equipment. According to the users, some were more user-friendly than others. Consequently, users had to learn or understand the different types of machines because they would not necessarily sign the same one out daily. Therefore, computer-use competencies or abilities came into question.
2. ETool monitors were maintenance mechanics assigned to assist the IT section with the laptops allocated to their respective sections. However, the monitors received no formal IT training and were required to work both the eTools and their primary aircraft maintenance duties simultaneously. Follow-up questioning revealed that at times, the combined duties overwhelmed the monitors causing one of the two

responsibilities to be reprioritized. This created a domino effect at different levels of the MRO operation. For example, when the monitors worked eTools issues, their primary duties had to be accomplished by someone else or left for another time. On the other hand, when the eTool duties were left for another time, the workload for the IT repair section increased. The increase in workload increased the repair cycle time because the monitors were forced to batch the equipment until they were able to transport them to the IT section for repair. Consequently, an increase in eTool repair and turnaround time typically forced shortages in equipment and possibly a slowdown in MRO maintenance production. The inefficiency in this system and potential consequences of the shortfall was also noteworthy.

3. During informal follow-up questioning, some participants were asked whether they were aware of procedures and eTool user responsibilities outlined in their organizational policies and documentation. All replies were negative; most all users replied that responsibilities came from rumors or other colleagues. This final issue regarding a gap in understanding procedures and policies was a final critical factor identified during observation.

Documentation

A review of documentation was performed in the Quality Assurance office. The purpose of the documentation review was to understand the program, its processes, and local guidelines of maintenance operating instructions. Additionally, the review provided a pathway to identify whether gaps existed in the interpretation or communication of these guidelines within the workforce.

Two maintenance operating instructions (MOI) and one technical order document was reviewed. The first MOI, 21-22 *Maintenance Technical Order Policy and Distribution Guidance* outlined specific responsibilities relative to the TO library program and its subaccounts within the entire maintenance organization. The second MOI, 21-16 *eTool Policy and Guidance*, charted clear responsibilities, guidance, and procedures in the handling of eTools and its associated equipment for supervisors, monitors, and users. The final document reviewed was TO, 00-5-1 *Air Force Technical Order System*. This manuscript provided AF level policy and procedures for the entire TO system to include subordinate programs.

A review of the documentation revealed interesting insights. First, most of the explicit responsibilities outlined in MOI 21-16 were specific to equipment monitors and not much detail explained information for users. Yet, users have physical and safekeeping responsibility of equipment throughout the entire workday. The review also suggested that there were specific monitor responsibilities inherent or applicable to users as well. For example, for decentralized eTool checkout areas, users must also be mindful to "Ensure eTool is plugged into its own unique power supply and drawer" (MOI 21-16, 3.2.4. 2014). An example of the importance of this one item is explained below.

Second, during follow-up questioning, users were unaware of the MOI 21-16 and the general information that provided guidance to avoid equipment damage that could cause increased IT workload and or equipment shortfalls. This information suggested two potential issues. First, communication about procedures and guidance are not effectively

reaching the workforce. Second, as the MOI guidance is not specific to users, thus, there is no sense of urgency is necessary.

The need to understand and communicate organizational policy, procedures, and guidelines is important as one part of the system can affect other parts of the system (Bertalanffy, 1972). For example, one of the most common but significant problems with this program happens when the laptops are returned to the wrong drawer. AF network protocol requires all computers to be assigned their own port or connection. Computers that are connected to the wrong port or returned to the wrong drawer are automatically locked out because the network acts as if there is a security breech. Thus, the port is shut down and the computer is automatically disabled. To repair this, all the computer software must be reloaded taking about 5 hours. Then, the port must be unlocked by the network administration organization. This translates to a full day of lost work for that tool as a result of a mismatch in connections. The need for managers to effectively communicate the MOIs and users to understand the impact of noncompliance is critical to the effectiveness of the program and the maintenance mission. Thus, by combining the documentation and the observation field notes, the evidence suggested that there was a need for improved MOI 21-16 guidance relative user responsibilities, with an emphasis on improved communication to the workforce.

Data Analysis

Analysis Process

Several iterations of data cleansing and organizing took place. During the first iteration of manually sorting data, the transcripts were coded with a focus on identifying

the factors and patterns among each interview question. However, an excess of supplemental information related to benefits, processes, and ideas for change were provided during the interviews. Therefore, since this information was not directly relevant to the research question, this supplemental information is discussed in Chapter 5. A thematic analysis technique was used to classify key data from the interview transcripts. To ensure a systematic and thorough development of codes and themes, the six phase model suggested by Braun and Clarke (2012) was used.

Hand coding. First, I thoroughly familiarized myself with the data making notes and annotating transcripts throughout the review. Second, initial codes were constructed to help interpret the data content specifically, focusing on data related to the research question (Braun & Clarke, 2012). Data that did not directly address the research question was parsed and codes were developed only for those key words, phrases, and ideas that related directly to answering the research question. Forty key factors were identified during this second iteration. Once the second iteration of hand coding was completed, these identified factors were further scrutinized and consolidated to 23 key factors. This process helped to facilitate the application of a more manageable force field analysis questionnaire.

In the third phase, the codes were organized and grouped with preliminary themes developed to help capture the overall meanings or ideas from the clustered data. Nine themes were initially developed then later reduced to eight. In an effort to ensure thoroughness, relationships between themes were also explored.

During the fourth phase, a final in-depth review was performed to ensure the codes appropriately related with their themes and to discard or relocate codes whenever applicable. During this concluding review, 23 key factors structured under 8 major themes were confirmed. At this stage, an independent reviewer crosschecked the coding to ensure soundness of interpretation of terms and protect against data entry errors. For the fifth phase, another review and refinement of the themes was performed to ensure they captured the uniqueness of the data. This phase also included drawing quotes from the transcripts to better articulate the major points in the study. The final phase involved the write up of this analysis.

After completing hand coding, NVivo10 was used to organize the data and provide confirmatory analysis using the following procedure: First, raw transcripts, informed consents, and collations of the hand coding were uploaded as external documents to the NVivo10 project. Entire interview transcripts were uploaded under each individual (parent node) with details of the interview sorted using a paragraph study as a child node. Once uploaded, the external sources were organized into datasets to include, interviews, informed consents, and of hand coded data. Next, parent nodes were created for themes developed during the hand coding and labeled according to their assigned names. Specifically, parent nodes included leadership, middle management, personal reactive barriers, resources, software application design, system technology, technical ability aptitude, and training. Below each parent node, listed the aggregated factors developed during hand coding and assigned as child nodes. The 23 established child nodes included accountability, communications, dual processes, ease of use software,

ease of use technology, emotional reactions, employee feedback leadership, employee feedback management, forced transition, habit, hardware challenges, implementation strategy management, implementation strategy leadership, information communication technology literacy, leadership support management, experience management, support, negative behaviors, program funding, single point of failure, training resources, trust, and user guidelines.

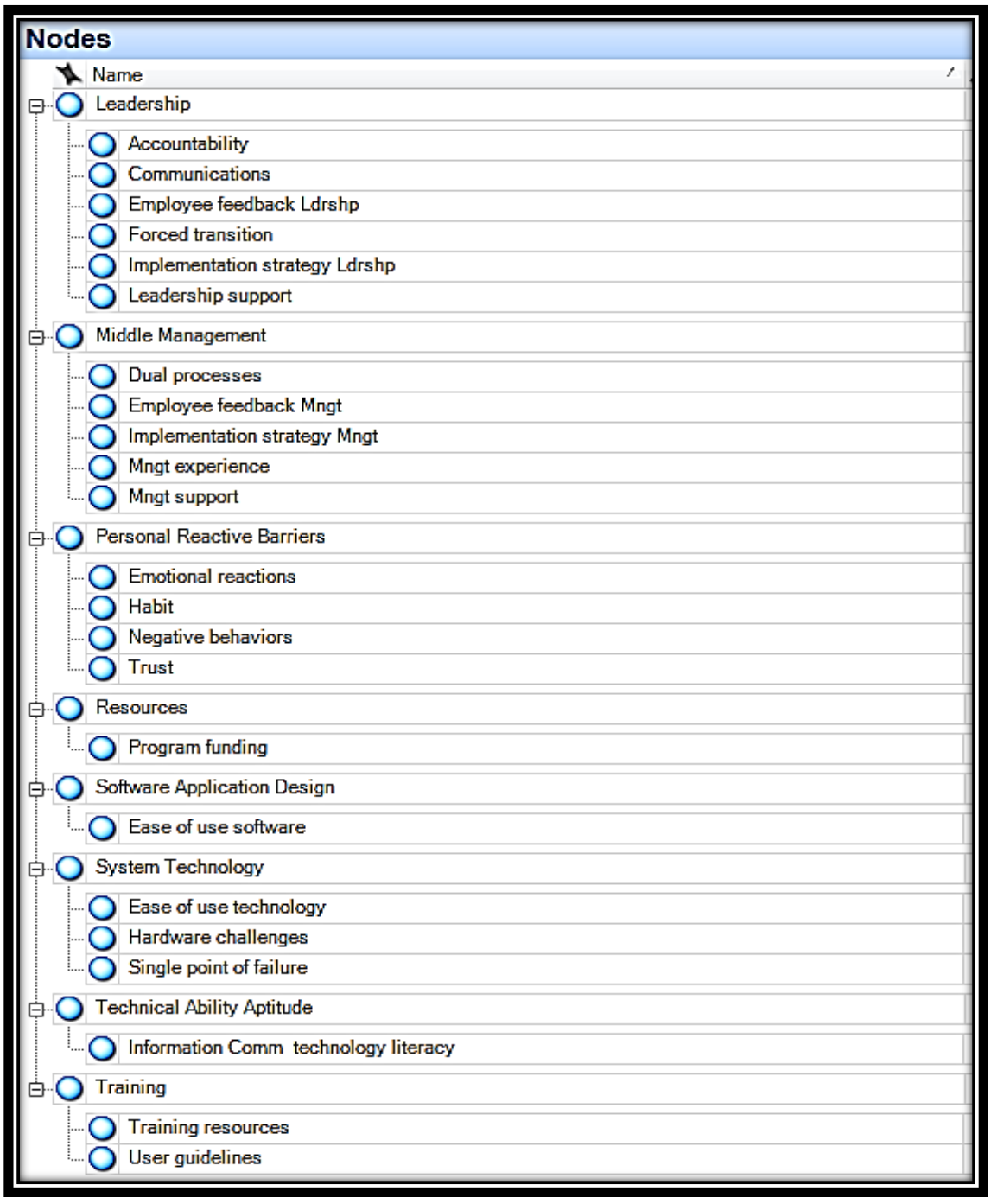

Figure 2. Themes and factors identified from interviews.

Data queries. After developing the hierarchy of nodes for themes and factors, several queries were run to further explore data collected during the 13 interviews using

the NVivo10 software. The first query run was a coding query. The purpose of this coded query was to test the ideas and relationships between the aggregated codes as confirmation of the hierarchy developed during hand coding. The secondary query run was a matrix-coding query; this compared the data collected across the developed nodes.

In the first coding query, the analysis was run seeking generalizations across all interviews for the 23 identified factors. During the query, 4,791 references were highlighted that referenced words generalized to the 23 factors identified during hand coding. This high count of references across the 13 interviews provided further evidence that the hand coding factors developed were appropriate and trustworthy.

A second query sought a word list for text query of top reported words. In this query several critical words stand out that should be noted with a recording of their number of uses in parentheses.

- Know/Experience (N=605)
- Support (N=571)
- Training (N=496)
- Use/Functionality (N=340)
- Management (N=217)
- Processes (N=144)
- Technology (N=143)
- Maintainer/Maintenance (N= 142)
- Force (N=132)
- System (N=129)

Evidence of Trustworthiness

Credibility

For this study, credibility was achieved by conducting member checking, crosschecking, and triangulation as described in Chapter 3. Member checking was

accomplished with all participants to ensure documented information was accurately interpreted and captured. Participants were emailed their interview transcripts and requested to ensure accuracy or provide correction if necessary. Other than some spelling errors, participants made few corrections and confirmed their transcripts as accurate by responding to their original emails. Crosschecking was accomplished during the coding of the transcripts. As codes and themes were developed, sorted, categorized, and condensed, an independent reviewer validated the interpretation of themes as they related to their codes. A comparison of the data ensured an agreement with the coding scheme and mitigated data analysis errors. This crosschecking step was noteworthy for the current study in addressing any potential personal or interpretation bias. Triangulation occurs when more than one source of data confirms similar findings (Patton, 2002). Specifically, positive triangulation was documented between the interview data and the force field analysis questionnaire results. Participants identified and confirmed that training was one of the two most important influences to the adoption and successful implementation of the eTool technology.

Transferability

Transferability and applicability of the findings and the action plans may be partially transferable because the sample used for this study was representative of most MRO organizations with flying missions. Most MRO organizations within the DOD are designed, operated, and managed using a similar culture and organizational structure such, as organizational maintenance structure, leadership hierarchy, maintenance philosophies, and system architectures. Additionally, the official instructions used as

guidelines for all of the above concepts are the identical for all standard AF maintenance MROs. However, due to the small sample size of just 13 participants, transferability is not likely possible until future research is conducted with a larger sample and population size.

Dependability

For this study, dependability was achieved by triangulating the findings from more than one data source. In an effort to demonstrate the trustworthiness of the data, an excel spreadsheet was developed to illustrate how the data evolved to its final state. This strategy not only reduced bias by providing trackback capabilities but also demonstrated the trustworthiness of the data. Objectivity was preserved by recruiting an independent reviewer to crosscheck both the triangulation process and accuracy of the data.

Confirmability

Confirmability was achieved by applying an audit strategy where an independent reviewer checked the accuracy of transcript coding and evolution of the coding process. This helped to confirm unbiased, consistent interpretation, understanding, and the accuracy of the final factors identified in this study. The use of an independent reviewer significantly increased the trustworthiness of the coding process and the findings in this study.

Analysis of Research Question Data

The following section presents the results of the data analysis and answers the research question. The results were guided by the force field analysis (FFA) framework used for evaluating success factors in implementing E-maintenance in MRO

organizations. The framework employed in-depth qualitative interviews to explore and identify factors that influenced employees of the MRO organization and questionnaires to rank the factors level of importance and its perceived degree of application.

This study answers the research question:

What are the socio-technical factors that inhibit the transition from a paper-based system to an electronic-based system in MRO organizations?

FAA Findings

The following presentations tell the story of the critical factors that influenced the implementation level of technology-enabled change in the MRO organization. Table 2 presents the key social-technical factors MRO employees identified as influencers to the transition from a paper-based system to a digital-based system. Predictive analytics software (PASW) software was used to capture and organize statistical data developed from the FAA questionnaires.

Employees identified 23 important factors, as they perceived negatively influenced technology-enabled change in the maintenance organization. Table 2 provides an understanding on how I interpreted the data. First, column 1 depicts the 23 important factors or influencers employees identified from both the interviews and questionnaires. Column 2 depicts the number of cases or responses obtained from this case study. Columns 3 and 4 illustrate the lowest or highest scores given for that particular factor. Column 5 shows the percentage of total participants that perceived the factor as most important. Column 5 is portrayed in and ascending order with level of highest importance on the first line. The following Likert scale represents how participants or employees

rated their questionnaire by the levels of importance: 0 = not important, 1 = slightly important, 2 = moderately important, 3 = very important, DK = Don’t Know/Don’t Understand.

Table 2

Factor Loading for Exploratory Frequency Analysis Using PASW Factors in Which Employees Perceived Negatively Influenced Technology-Enabled Change.

Factors or Influencers	# of Responses	Min. Rating Response	Max. Rating Response	Participants % of Importance
Employee Fdbk Ldshp	13	3	3	100%
Employee Fdbk Md Mgmt	13	2	3	97%
Leadership Support	13	2	3	97%
Communications	13	2	3	95%
Trust	13	2	3	95%
Dual Processes	13	2	3	95%
Ease of Use Software	13	2	3	92%
Ease of Use Technology	13	1	3	92%
User Guidelines	13	2	3	92%
Information Literacy	13	2	3	92%
Training Resources	13	2	3	90%
Single Pt Failure	13	1	3	87%
Accountability	13	2	3	87%
Habit	13	1	3	87%
Implemt Strag Ldshp	13	2	3	87%
Program Funding	13	2	3	87%
Hardware Challenges	13	0	3	85%
Negativity	13	1	3	85%
Emotional Reactions	13	2	3	79%
Forced Transition	13	1	3	77%
Md Mgmt Support	13	1	3	77%
Implemt Strag Md Mgmt	13	1	3	67%

Note. Some factors in column 1 have been abbreviated to facilitate table space. Employee Fdbk Ldshp = employee feedback leadership; Employee Fdbk Md Mngt = Employee feedback middle management; Implemt Strag Ldshp = Implementation strategy leadership; Md Mgmt Experience = middle management experience; Md Mgmt Support = middle management support; Implemt Strag Md Mgmt = implementation strategy middle management.

Table 2 illustrates several important points of analysis. First, all participants considered all 23 factors as moderately important to very important 2-3 based on a 0-3 point Likert scale. Second, each factor scored no less than an average of 2 across all 23 factors revealing, that participants perceived each factor as necessary for the success of the maintenance program. Third, of all factors, 100% of the participants interviewed considered employee *feedback to leadership* as the most important factor.

The FFA model provided the framework to answer the research question. A review of the model required the researcher to: (a) identify factors that influenced behaviors, (b) rate factors based on their level of importance, (c) determine which factors could be positively manipulated to drive change, and (d) develop recommendations or action plans for positive change (Lewin, 1951). However, during statistical analysis, other considerations emerged from the factors rated based on level of importance. This was because all identified factors ranged on the high end of the Likert scale, 2-3 (Table 2), moderately important and very important. Consequently, this near one-sided agreement made these results impractical to plot or discuss individually. Therefore, the most important factors among the 23 were identified using Pareto's 80/20 rule.

Pareto's 80/20 rule states that 80% of the issues may be addressed by 20% of the causes (Reh, n.d). Thus, for this study, the six highest rated or most important factors were selected for discussion. The six factors that participants or employees perceived as most important were the following: Employee feedback to leadership (Employee Fdbk Ldshp), Employee feedback to middle management (Employee Fdbk Md Mgmt), Leadership support, Communications, Trust, and Dual processes.

The following section employs the third phase of the FAA framework. This is where the participants rated the factors in which they perceived could be positively be manipulated to drive change from an employee perspective. To better clarify the results in this section of the FFA, both the results and tables for each of the six factors are explained in the following subsections.

Tables 2-7 illustrate how participants rated the top valued factors as they perceived as implementable for positive change. The following Likert scale defines the level of difficulty in which participants scored each factor: 0 = very difficult, 1 = somewhat difficult, 2 = somewhat easy, 3 =very easy, DK = Don't Know/Don't understand.

Table 3

Number of Frequency Reponses to: Employee to Leadership Factor.

Level of Difficulty	Frequency	Percent	Valid Percent
Somewhat Difficult	4	30.8	31%
Somewhat Easy	4	30.8	31%
Very Easy	5	38.5	38%
Total	13	100.0	100%

Employee feedback to leadership. One hundred percent of all participants considered employee feedback to leadership as the most important factor of the 23 captured (Table 2). Sixty-nine percent of the participants believed that this factor would be very easy or somewhat easy to implement and 31% believed it would be somewhat difficult. Although this factor was identified as most important, participants were evenly divided on its ability to be implemented.

Employee feedback to leadership, relates to the need for an established and reliable feedback process where employees and upper level leaders can exchange information, ideas, and concerns about maintenance issues, organizational changes, and challenges that effect business practices. Employees expressed anxieties about their ability to have a voice about the needs in the maintenance area. One participant who was concerned with changes being made in a vacuum stated, "People who are making decisions with money don't know what it's like to work on a flight line." Another participant was concerned about how senior leadership implemented technology-enabled change and stated that, "I think there's a lot of assumptions in regards to what everybody should know, when in reality, it's not that way." Thus, participants felt communication with feedback to senior leaders was essential for positive change to take place.

Table 4

Number of Frequency Reponses to: Employee to: Employee Feedback to Middle Management.

Level of Difficulty	Frequency	Percent	Valid Percent
Very Difficult	1	7.7	8%
Somewhat Difficult	2	15.4	17%
Somewhat Easy	6	46.2	50%
Very Easy	3	23.1	25%
Total	12	92.3	100%
Missing System	1	7.7	
Total	13	100.0	

Employee feedback to middle management. Ninety seven percent of all participants surveyed considered employee feedback to middle management as the

second most important factor of the 23 captured (Table 2). Seventy five percent of participants believed that this factor would be very easy or somewhat easy to implement. Twenty five percent of the participants believed that this factor would be somewhat and very difficult to implement.

The *Employee feedback to middle management* factor represented a perceived disjointed relationship between management and frontline employees. This factor was related to the need for an established process where employees could provide comment or feedback about work concerns, actions, and the effects of changes. Thus, with the current verbal method, the sense of urgency or importance to address concerns differs in scope between managers and employees. One frustrated participant stated, "Who knows better what I need than myself, because I'm the one doing the job." Another participant stated after bringing up several concerns, that all they got from management was "Lip service to a problem like... yeah were addressing that, or that's being considered, or we don't have money to do that right now." Employees believed that an established feedback process where voices could be heard, issues tracked, and addressed would be integral to improving organizational efficiency and positively moving technology-enabled change.

Table 5

Number of Frequency Reponses to: Employee to: Leadership Support.

Level of Difficulty	Frequency	Percent	Valid Percent
Very Difficult	1	7.7	8%
Somewhat Difficult	3	23.1	23%
Somewhat Easy	4	30.8	31%
Very Easy	5	38.5	38%
Total	13	100.0	100%

Leadership support. Ninety-five percent of all participants surveyed considered leadership support and the subsequent 3 factors, communication, trust, and dual processes equally as important (Table 2). For this key factor, **e**mployees expressed considerable frustrations in working with technology to perform aircraft maintenance. One participant stated that, "A more hands on approach from middle and upper management. They need to be more involved at the ground level and have a genuine interest in how the user is dealing with this from day to day."

Leadership support for eTool training was considered an important issue because based on this feedback, it was an oversight. Participants felt that current computer skills barely kept pace with the mission requirements and the operational pace of the maintenance environment. One reason was because users didn't understand how to use the various models of eTools employed throughout the maintenance complex; this issue was noted during the observation. A second major reason was because of the lack of knowledge in navigating through the maintenance technical data. One participant said, "I wish more training would be…in regards to how to use the laptop, I believe that would help us all here, in the maintenance field." Another participant stated, "We don't have any training that I know of, if you know of some let me know." A third participant stated, "There are …guys out there who still struggle with using the eTools." Another participant comment stated…"management actually threw it upon us and said this is what we're going to be using now. There was really nothing that we could have actually said or do about it because they took away our TO's (paper) anyway." One participant commented, "It was like, if you didn't have the skills…you [could've been] were in trouble."

Table 6

Number of Frequency Reponses to: Communications Factor.

Level of Difficulty	Frequency	Percent	Valid Percent
Somewhat Difficult	4	30.8	31%
Somewhat Easy	6	46.2	46%
Very Easy	3	23.1	23%
Total	13	100.0	100%

Communication. Sixty-nine percent of the participants surveyed believed that the communication factor was very to somewhat easy to implement. The communication factor refers to the need for consistent reliable communication from top to bottom and across the maintenance organization. During the interviews, participants expressed concern and confusion about learning about changes in maintenance practices via rumors, chatter, during breaks, and on the fly. One participant stated, …"because of the Air Force has so many different levels, the message tends to get watered down… and sometimes, if you didn't have a lot of the middle guys…it's easier to get these changes implemented. In other words, too many layers of managers are confusing the context of the messages." Another participant concerned with direct leadership level communication stated, "I think, some stuff goes up and down, other stuff doesn't. It will reach my immediate boss, but I think sometimes it just dies right there." During a night shift interview, we talked about communication, one participant stated, "That's…a big complaint, I bring it up…then I don't hear anything back. So, 3 or 4 months go by, I'll bring it up again to somebody else and… that's the first time I heard about that…typical."

Table 7

Number of Frequency Reponses to: the Trust Factor.

Level of Difficulty	Frequency	Percent	Valid Percent
Somewhat Difficult	6	46.2	46%
Somewhat Easy	6	46.2	46%
Very Easy	1	7.7	8%
Total	13	100.0	100%

Trust. For the trust factor, 54% of participants felt that this factor could be somewhat easy and very easy to implement. The remaining half or 46% believed it would be somewhat difficult and no one said it would be very difficult. For the trust factor, participants expressed numerous perspectives related to both system trust and their own computer literacy skills.

Participants felt that *trust* was important because it related to two significant issues. First, some participants didn't trust in their own technical abilities in operating the eTool technology and in navigating the software to find the applicable technical data. Second, users were not confident in the new electronic/digitized system itself because of their lack of understanding versus the many years of experience in using paper technical manuals. This appeared to be a personnel anxiety issue that kept some resisting the change to electronic technical manuals. These personal barriers were more significant for the "seasoned" personnel. One participant stated, "You will always find it the hardest thing…that any human being has to do is change." Another participant stated, "Some of the more mature guys are not computer savvy, they won't use it... they're going off their knowledge." Another participant commented that for "Some of the older folks that I

know…there was a fear…of not being able to find what they needed to find, and even spending a lot of time …I still see it now."

Table 8

Number of Frequency Reponses to: the Dual Processes Factor.

Level of Difficulty	Frequency	Percent	Valid Percent
Somewhat Difficult	5	38.5	38.5%
Somewhat Easy	5	38.5	38.5%
Very Easy	3	23.1	23%
Total	13	100.0	100%

Dual processes. For the dual process factor, a combined 62% of participants felt that this factor was somewhat and very easy to implement or amend. Thirty eight and ½ percent felt it was somewhat difficult and no one believed it would be very difficult. Under this factor's description, dual process was an undesirable practice that required the organization using two data formats of the same information with different rules associated.

The dual process factor was an issue because it was perceived with both positive and negative implications. Dual processes relates to employing the use of technical data in 2 different formats, digital (via eTools) and paper technical manuals. First, participants felt that dual processes were adding more confusion because the rules are different for maintaining and using the data between both formats. For example, digital technical data is electronically updated daily whereas; paper updates deliver between 4-6 weeks. Therefore, the electronic data is more current than the paper consequently; different rules apply to users and its use depending on the format used at the time. Nevertheless, since

the organization has not fully transitioned, dual processes have become a necessary evil because both are used until one is completely removed. Second, many employees are not in favor of giving-up paper. One participant stated, “Some guys are not able to adapt to it, they don’t want to use it. There are old school guys that have always used paper. They don’t want to go to a digital type format. Another participant stated, “a lot of technicians were against going from paper to electronic, but a lot of that was because we felt like it was being pushed down our throat.”

Action items. The final phase of the FFA framework was to develop action items or plans for change. To assist with this, participants identified 3 actions in which they believed would help improve the implementation of eTool/eTO technology program and efficiency of the MRO organization. Their responses provided a final contribution to what they perceived would help improve the program, organizational efficiency, and the implementation of the eTools in the MRO organization. These items are explained in Chapter 5.

Summary

Chapter 4 described the summary of the data collection procedures and the results obtained from the multiple data collection points grounded in the FFA framework. Appropriate steps are identified to ensure informed consent and ethical data collection procedures were adhered. First, a small-scale pilot study ensured the interview questions, protocol, and questionnaire was accurate, appropriate, and refined for the main study. Second, multiple data collection events were conducted such as, interviews, observations, documentation and a questionnaire. Third, a report of the results from the data collection

events and how they were thoroughly analyzed. The information captured helped to shape the findings in this study and answer the research question: What are the socio-technical factors that inhibit the transition from a paper-based system to an electronic-based system in MRO organizations?

Although participants reported personal frustrations and technology shortcomings, the analysis of the results exposed a management centric shortfall, a fundamental misconception in training, and a false assumption that computer technology is easily comprehendible across all personnel. Participants reported that these barriers were easy to somewhat easy to positively amend or implement. Chapter 5 presents a detailed interpretation of the finding and results captured from this chapter. Chapter 5 also includes discussion and implications for change.

Chapter 5: Discussion, Conclusions, and Recommendations

This study examined the socio-technical factors that have inhibited the transition from a paper-based system to an electronic-based system of one MRO organization. A force field analysis framework effectively captured the perceptions, needs, and viewpoints of the MRO personnel. Literature grounded in change theories and technology acceptance models helped to conceptualize the problem of why after more than a decade technology-enabled change has not been fully realized in MRO organizations. Key factors exposed management centric findings such as, communication, implementation strategy and organizational readiness.

The next section presents my interpretation of the findings. Following is a comparison of the literature Chapter 2 with results from the current study. Next, I interpret the findings based on experience and limitations of the study. Finally, I provide recommendations focused on application to research and improving implementation of current and future technology-enabled change initiatives.

Interpretation of Findings

Implementation strategy. The findings in this study confirmed a key oversight. There was no real strategy implemented for the technology-enabled change in the workplace. This became the fundamental driver that supported the issues identified as key factors exposed during data collection. A paradigm shift from paper to digitized maintenance practices with no clear implementation strategy triggered confusion, resistance, and uncertainty issues from both management and employee levels throughout organization. Some maintainers learned how to adapt to the new maintenance philosophy

through trial and error, others had some computer skills to get by, and some have yet to use eTools. Those who had not used eTools were said to be performing maintenance from memorization and with paper manuals still made available.

During interviews, all participants indicated that they understood the concept for modernizing the maintenance practices and the benefits that digital technology provided. In fact, participants were pleased that they no longer needed to carry numerous books to the flight line or worry about out-of–date data. Some also recognized that there was a positive future with the technology such as, access to emails, online training, and other maintenance activities that normally wait until the end of the day for access to the Internet. However, the approach used in getting to this point is what personnel believed contributed to resistive behaviors, delays in practice, and ultimately an enduring paper process. One participant said, "We don't go to war without a plan." For example, users indicated that navigating through the information was tedious and time consuming using both the hardware and software. One user stated, "It took us too long to find [out] the information." We really weren't trained on the possibilities of how to use it and we were just taking too much of our own time…that's the reason why it took us so long and why we all had that negativity."

Common DOD thinking is, once a change initiative is directed downward, the *how* is typically left to the commanders to figure out. However, in many cases, that same approach is assigned to workforce managers with little experience in change strategies or time to develop, plan, train, or logically execute large-scale change initiatives. As a

result, full-scale implementation lingered between transition and the long-term changeover became the reality.

In the literature, effective technology-enabled change was conceptualized by the use of dedicated and trusted change agents assigned from within the organization (Hornstein, 2008). This not only allows management to focus on day-to-day business, but also ensures consistent information exchange focused on shaping attitudes, beliefs, and values in support for the change initiative. Westover (2010) postulated that change agents not only work towards transitioning behaviors but also concentrate in promoting and fostering the new behaviors for growth and stability. When referring back to the literature, this concept reflects the *refreezing* stage of Lewin's (1951, 1958) classical three-stage change model. Another way in which the unit could have ensured effective change was in establishing an organizational readiness posture.

Organizational readiness. The demands imposed on aircraft maintenance organizations to meet flying goals, maintenance schedules, and production timelines require strict and coordinated activities that vary from base to base. This is especially challenging when there are a large amount of aircraft and people assigned like the organization in this study. Consequently, the ability to prepare the organization for change was yet another undertaking which in this case appeared to be narrow in focus.

Organizational readiness for change is a multilevel construct and a precursor to successful implementation (Weiner, 2009). Readiness refers to the organization's shared belief that by committing to change there would be positive benefits or outcomes. This commitment is often based on resources, task demands, and other organizational

situations (Weiner, 2009). Thus, for this investigation, potential competing priorities took precedence over developing a readiness posture to shift organization into the new digitized maintenance concept. Users were not aware, trained, or involved in decisions or discussions in the changing environment. Participants alluded to factors such as, forced transition, hardware challenges, lip service, and most frequently mentioned, training. Kantor (2012) suggested that change is generally resisted when imposed upon people suddenly with little time to prepare.

In drawing from the literature, Lewin's (1951,1958) three-stage change model can ideally be prescribed to create organizational readiness. Thus, readiness can be achieved by implementing communicative strategies focused on unfreezing mindsets fixed on the status quo. These strategies should communicate the importance of change, emphasize the differences between the current and desired states, underscore dissatisfaction with the status quo, and or motivate a sense of urgency. Other unfreeze strategies can be connected to on-time training, adequate resources and support, performance incentives, and awards. By unfreezing past norms, employees will be open-minded to new ideas that help to enable change and facilitate a key aspect of organizational readiness.

The TAM model (Davis et al., 1989) described in Chapter 2, provided a different perspective, suggesting that individual intentions to accept, adopt, or change are motivated by their perceptions of conditions, circumstances, and confidence levels. Thus, based on the results of this study, it is conceivable that readiness was influenced by factors such as perceived usefulness (of the technology) and perceived ease of use which

are factors grounded in the TAM model and directly correlated to training (Rodriguez, 2012).

Top factors in this study were a result of two highlighted communication shortfalls. First, an inconsistent communication processes were directives/changes were learned via rumors or other unofficial channels. Second, the absence of a feedback process where management can address and answer workforce concerns.

Communication. Vasile (2009) stated, "The major role of information is to reduce uncertainty due to an imperfect knowledge of a reality" (p. 185). Participants specified two major communication issues within the organization. First, participants revealed that top down communication were disjointed. Second, there were no feedback processes where management can formally address concerns important to the workforce.

Consistent and reliable communication from top management and across the frontline workforce was perceived as disjointed especially, relative to this change initiative. This factor was exposed from the interviews, questionnaires, and during the post observations interviews mentioned earlier. Thus, unreliable information may have contributed to the long-term implementation process. This is because employee uncertainty could have created instability problems that lead to low morale, low commitment, and ultimately resistance to change (Vasile, 2009).

Participants conveyed a need to voice concerns relative to organizational changes and policies affecting work practices. This was significant because they felt that important issues were not reaching upper management or that some in the chain just didn't care. Participants believed that their involvement could have prevented many

technology acceptance issues. Thus, a lack of voice or involvement about important issues could have driven a low sense of urgency for the workforce to transition to digitized systems. Chapter 2 includes the description from several researchers that postulated user involvement as effective for implementation of technology-enabled change (Ji-Tsung &Markus, 2006; Legris &Collerette, 2006; Venkatesh et al., 2003). Conversely, some planners still trust that the most efficient way to plan and execute change is to involve the fewest people possible. Nevertheless, it has often been proven that stakeholder involvement from the beginning prevents countless difficulties in the long run (Aquirre & Alpern, 2014). The negative outcomes of Project X, highlighted in Chapter 2, underscore real-world negative effects of technology-enabled change deprived of user involvement and a key motivation for this study.

Limitations of the Study

This study consisted of several data collection activities to include, in-depth interviews, documentation review, observations, and questionnaire. The potential limitations in this study were in accomplishing all collection activities around fluctuating work schedules. Although these challenges required intensive rescheduling, there were no notable effects other than short delays to the overall data collection events. All participants had a chance to contribute.

This study was conducted in one MRO organization among dozens within a DOD. Thus, one limitation was in the small sample size used within this significantly large and diverse DOD maintenance workforce. However, as mentioned previously,

homogeneity among the population is higher when compared with more typical populations.

Another limitation was that sample population was an all civilian workforce. Consequently; the results of this research may only be partially transferable across the civilian segment of the larger population. Other segments within the DOD aircraft maintenance community include military, civilian, and contractors. However, due to limited funding and resources, it was not possible to perform the study at a location where there was mixed maintenance population. Thus, while theoretically, the results might be transferable further research is required to confirm transferability of results to other populations.

Recommendations

The force field analysis framework required the researcher to: (a) identify factors, (b) rate factors, (c) determine those that can be positively manipulated, and (d) develop recommendations or action. Thus, the results from the aggregated data were used to develop the following action plan that can potentially decrease or eliminate current negative factors generated from this study. In addition, lessons learned from this study may assist in improving future technology-enabled change initiatives.

Establish eTool training. Throughout 100% of the interviews and approximately 70% of the questionnaires, participants reported eTool training as a key factor of technology acceptance and effectiveness in the workplace. One participant suggested, "A standardized training program based on particular e-tool characteristics and program content." Another suggested, "Establish a basic level of understanding using ETools prior

to operational use in a maintenance environment." A third participant proposed "A training video… for laptop and tablet orientation and use; it could even go as far as describing Maintenance Operating Instructions and related information about the proper use and handling of the e-tool equipment." All suggestions were noteworthy because participants reported that there were several eTool models in use and each had different features and limitations to understand. This issue made maintenance especially untimely and extra complicated for employees with limited computer literacy skills.

Action. In considering the variety of data analyzed and reviewed, a specific set of action sets is presented related to the parameters of the FFA. Specifically, the following are appropriate action steps that should be considered by future organizations engaged in this type of transition.

- Establish an eTool hardware and software training program
- Provide initial eTool training during organization in-processing
- Provide consistent familiarization training after new eTool model purchases in addition, participants also described a need for:
- ETool responsibility, safe keep, care, and accountability training.

This approach would train users on how to care and maintain the equipment in their custody and the consequences of abuse.

Establish feedback process. According to the data, 100% of the participant's felt that feedback between employees, middle, and senior management levels was very important and essential to organizational efficiency. Users felt that changes in maintenance practices were made in a vacuum and that issues that arose during and post

implementation could have been reduced or eliminated if communication within the chain was consistent and more reliable.

Action. Following the precious model, these are the recommended action steps for establishing a feedback process. Specifically, establish a SharePoint site (already available to DOD) where maintenance personnel have access. A suggestion could be that the site may be rendered as a dashboard that automatically initiates on desktop PCs and as an icon for the eTools. The following are suggested SharePoint forums: (a) management announcements, (b) personnel comments, (c) management feedback to comments (tracked), (d) organizational reports, and (e) awards program section. As a routine, the forum must be socialized during the in processing of all new personnel.

Other recommendations. People must implement change but just because one is in charge of change doesn't mean they know how to implement it. Thus, another recommendation would be to train managers in strategies that will help reduce resistance to organizational change. Strategies that help to effectively socialize change identify needs, address needs, and transition new behaviors. These strategies could be as simple as workforce interviews, just-in-time training, policy revisions and so on.

Recommendations for future research. This study provided needed exploratory groundwork to understanding a way to improve the implementation of technology-enabled change in maintenance organizations. A FFA framework as part of an exploratory case study provided a sound process that facilitated the identification of factors (e.g., reasons, causes, perceptions, and attitudes) that influenced the employees thinking as a result of change initiative. The results of this study provided just a snapshot

of a single organization and were representative of one segment of the maintenance population. Thus, future studies should include a duplication of this method with a larger population of this segment and later a mixture of all three of segments in the maintenance entire population. This could not be accomplished with the current study due to costs and the geographic distances between groups. However, to reduce costs while capturing a data from the larger population, an in-depth questionnaire could be used in place of observations and interviews. The current study contributed to the feasibility of a larger, more generalized questionnaire by providing identified factors as a baseline for developing future measures. Additional quantitative data, such as personnel demographics, size of organization and education and experience levels could also help in understanding the bigger picture**.**

First, the results of this study should be replicated with a larger population of the same civilian segment as in this research. This will help to establish whether results of this study are transferable to DOD civilians in maintenance organizations. Next, the study should be conducted on sites where there are a mixed population of DOD maintenance personnel to include, civilians and military employees. This would help determine whether the issues or factors among employees with mixed working cultures differ in comparison. Thus, it may be conceivable that a diverse maintenance population adapt to change better or worse than that of a single segment, if so, why. Such a study could contribute to best practices in understanding organizational alignment and the variables associated with technology-enabled change in diverse and non-diverse maintenance organizations.

Implications

There were a few implications of positive social change derived from this study. First, this research provides a clear understanding that people and technology must work as one system for technology-enabled change to be successful. Second, by understanding the factors that influenced the perspectives of employees from three working levels, future technology plans can be improved for DOD change initiatives. Hence, an empirical roadmap that contributes to the development of best practices for technology initiatives that address common socio-technical issues of the organizational employees and technology-enabled change. A final implication to social change is an improved strategy that eliminates partial transition that has resulted in dual processes, confusing policies, and a considerable waste of resources and tax dollars (A. Person, personal communication, April 2, 2013).

Conclusions

The goal of this exploratory case study was to identify factors that influenced technology-enabled change in one MRO organization. The reason was because transition from a paper to a paperless end-state has taken more than a decade for MRO organizations as a whole. The slow-moving changeover has resulted in significant costs in resources throughout the DOD.

The results of this study included aggregated data from interviews, observations, and documentation. A force field analysis design exploited important factors that influenced the perceptions of employees affected by the change. Participants rated factors by importance and their ability to implement, then provided actions based on their

experiences. Thus, this study may be used as a guideline to better analyze, identify, and reduce the barriers that affect people and change. Moreover, it may instill an improved understanding that technology-enabled change and managing change should be planed concurrently because poor transition could cost more than the change may be worth.

During the course of this study, I reflected on my personal experiences specifically by witnessing a continuous dysfunctional cycle of management expectations relative to people and change. Biased by both experience and personal convictions, technology-enabled change and people issues can damage the successful implementation of any change initiative regardless of how modern. Yet, DOD leaders, planners, and managers continue work on the assumption that change will be transparent, people are resilient, and that transition will take place one way or another. Thus, this laissez-faire philosophy continues to cost U.S. taxpayers millions of dollars in after-the-fact fixes and workarounds to satisfy people requirements and implementation issues once the damage is done. Reactive in nature, this mindset and approach to change dulls the excitement, stales the benefits, and demonstrates an absence of professional planning. Therefore, decision makers, planners, and implementers must consider the use of change management approaches to logically transition organizations to the desired state and avoid issues that increase the cost of change.

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Appendix A: Letter of Cooperation

DEPARTMENT OF THE AIR FORCE
12TH FLYING TRAINING WING
JOINT BASE SAN ANTONIO – RANDOLPH

MEMORANDUM FOR: Mr. Peter R. Toves

FROM: 12 FTW/MX

SUBJECT: Approval to Conduct Research

1.Based on my review of your research proposal, I give permission for you to conduct the study entitled, Evaluating Critical Success Factors in the Implementation of Large Scale Technology Programs in United States Air Force Organizations' within the 12th Fighter Trainer Wing Maintenance Group.

2. As part of this study, I authorize you to solicit up to twenty volunteers using our organizational email group system, conduct interviews and post interviews after the observation periods. Perform non-interactive observations on personnel during use of equipment and in performance of their maintenance activities. Review local maintenance instructions and documentation and conduct a survey after data is aggregated. Individuals' participation will be completely voluntary and at their own discretion.

3. We understand that our organization's responsibilities include: Provide an area or room for interview sessions. Allow access to maintenance areas for conducting observations. No supervision for your activities will be necessary. We reserve the right to withdraw from the study at any time if our circumstances change.

4. I confirm that I am authorized to approve research in this setting. My deputy, Mr. Bob Hamm, will make sure Mr.Toves has everything he needs to complete this project.

5. I understand that the data collected will remain entirely confidential and may not be provided to anyone outside of the research team without permission from the Walden University IRB.

ROBERT J. WEST, GS-15, DAF
Director of Maintenance

Appendix B: Interview Guide/Questions

A. Preparation Activities
    - Purchase and test digital recorder
    - Ensure to bring notebook and pens
    - Print copies of signed consent forms
    - Review interview questions
    - Record background and site, relative to position in organization as it relates to the eTool/eTO program

B. Interview Activities
    - Review consent form and ensure participant signature
    - Brief participant on purpose of the interview an organization of the data collection activities
    - Ice breaker questions to help ease participant and lead-in to the importance of the study
    - Discuss the general concept of the interview and its importance
    - Conduct interview beginning with open ended questions
    - Ensure focus on topic and probe for clarification
    - Look closely for non-verbal's and ensure they are captured
    - Record personal observations

C. Post interview Activities
    - Generate notes relative to impressions, observances and attitudes
    - Listen to recording to makes sure questions and answers were captured
    - Record personal reflections
    - Determine if follow-up interview is necessary
    - Submit recording to transcriber

Semistructured Interview Questions

1. **Research Question** - What are the factors that have inhibited the transition from a paper-based system to an electronic-based system?

    Interview questions:

    1. What are the barriers to transitioning from paper to digital technology?
    2. What are the benefits to transitioning from paper to digital technology?
    3. Who supports the change to digital technology? Why?
    4. Who is against the change to digital technology? Why?
    5. What are the risks in changing to digital technology?
    6. What other business processes might be affected—either positively or negatively?
    7. How difficult is this change to make?
    8. Do you have the necessary resources: training, support, tools, and time to make this transition?
    9. What would you do differently? Why?
    10. What are your concerns about this transition? Does your leadership understand them and taking appropriate action?
    11. Are there any other comments about this transition?

Appendix C: FFA Questionnaire

FAA Questionnaire
Evaluating Effective Technology Implementation Questionnaire:
Follow-up Questionnaire
Once again, thank you for taking valuable time to complete this study. This is the final part of the study, and you are receiving this follow-up questionnaire, along with a possible follow-up phone call to discuss your responses and any final questions you might have. Your opinions and experiences are valuable in helping improve future research related to the effective implementation of large scale technology. ***PLEASE REMEMBER YOUR ANSWERS ARE CONFIDENTIAL.***
· Part A of the questionnaire asks you to rate a list of factors by their importance in the effective implementation of the eTool/eTO program and how easy you think it would be to implement each factor.
· Data from this questionnaire will be synthesized into the overall findings of the research study and will be shared with the participating organization. However, **NO IDENTIFYING INFORMATION will be included**; all data will be included in aggregate form.
· Part B of this follow-up questionnaire asks you to provide specific ACTION ITEMS. These items are specific objectives you would like to see implemented in the area of **effective technology** implementation ***research*** in order to make it easier for the organization to use empirical research to inform frontline maintenance practices.
Please feel free to add extra comments as desired. It is critical to add the voice of front-line users and managers of the eTool/eTO technology program; this will help to identify potential strategies to improve technology implementation research. **The purpose of this study** is to obtain your unique experiences, opinions, and perceptions regarding factors that influence maintenance business practices as the AF continues to transition into a paperless paradigm. All information collected during this questionnaire will remain confidential and no identifying information will be used in relation to your responses.
Part A: Factors
BARRIERS
A. In the first column are identified factors that might hinder the maintenance repair and overhaul organization (MRO) from effectively implementing and using eTools/eTOs (Barriers).
B. In the second column, using a scale of 0 to 3, please indicate how important you think each factor is to effectively implement eTool/eTO in the MRO where:
0 = not important, 1 = slightly important, 2 = moderately important, 3 = very important, DK = Don't Know/Don't Understand

C. Then in the third column, using a scale of 0 to 3, please indicate how difficult you think it would be to implement each factor in the organization where:		
0 = very difficult, 1 = somewhat difficult, 2 = somewhat easy, 3 =very easy, DK = Don't Know/Don't Understand		
	2. *How important do you think this factor is for effectively implementing the use of eTools in the MRO organization*	***3.*** *How difficult do you think it would be to implement this factor*
1. If the maintenance repair and overhaul organizations were able to provide ……		
Organizational policy and or enforcement of policy that ensures employees are held accountable for the care of the ETool equipment in their custody….	Click for Level of Importance	Click for Level of Difficulty
Consistent and reliable top level communication flow concerning all changes in maintenance practices…	Click for Level of Importance	Click for Level of Difficulty
Employees with an approach to improving confidence, trust, and technical abilities in using the digitized tech data system…	Click for Level of Importance	Click for Level of Difficulty
One process that eliminates employee confusion regarding the rules for using two different tech data formats (paper/digital) and processes to perform aircraft maintenance actions…	Click for Level of Importance	Click for Level of Difficulty
An improved tech data capability that reduces tedious and time consuming process in navigating through large volumes of technical data files of using a low standard PDF file format…	Click for Level of Importance	Click for Level of Difficulty
An established program that provides a practical and functional understanding of the various types of eTools employed within the maintenance organization...	Click for Level of Importance	Click for Level of Difficulty
An established process where employees can provide constructive feedback for issues concerning maintenance observations/issues, corrections, and or suggestions…	Click for Level of Importance	Click for Level of Difficulty
A consistent and involved relationship between management and frontline employees relative to feedback about work concerns, actions, and	Click for Level of Importance	Click for Level of Difficulty

necessary follow-ups…		
An organizational strategy that focuses on alleviating common employee fears and frustrations relative to committing to using the technology driven tech data system...	Click for Level of Importance	Click for Level of Difficulty
A change management approach that reduces or eliminates the need for a forced transition/changeover during the implementation of technology centered initiatives...	Click for Level of Importance	Click for Level of Difficulty
Leadership support regarding an established training program or guidance for using the eTool equipment…	Click for Level of Importance	Click for Level of Difficulty
Written guidelines explaining the limitations/care of the equipment such as, are the eTools waterproof, can the battery be swapped while turned-on, etc.	Click for Level of Importance	Click for Level of Difficulty
A system that supports technology acceptance by improving computer skills that will enable the transformation of longstanding maintenance habits...	Click for Level of Importance	Click for Level of Difficulty
A higher standard of eTool quality that reduces damage frequencies and are usable under difficult maintenance conditions such as engine runs, preflight and aircrfaft servicing tasks…	Click for Level of Importance	Click for Level of Difficulty
A strategic implemenation strategy focsing on managing organizational change and/ or how to transition from one maintenance practice to another	Click for Level of Importance	Click for Level of Difficulty
One standardized technology implementation strategy employed throughout the entire maintenance organization…	Click for Level of Importance	Click for Level of Difficulty
An approach to improve technology literacy levels focused on use, functionality, and the capabilities of the eTools dedicated for aircraft maintenance practices…	Click for Level of Importance	Click for Level of Difficulty
Reliable program funding that provides appropriate eTool quantity levels, sufficient technical support personnel and required external training when necessary...	Click for Level of Importance	Click for Level of Difficulty
An experienced middle management team proficient in using the digitized tech data system and capable of identifying with issues that are important to the users of the technology…	Click for Level of Importance	Click for Level of Difficulty

Realistic management support that positively influences transition from the current state to the desired digital end-state for maintenance	Click for Level of Importance	Click for Level of Difficulty
A training program that can decrease the learning curve experienced by new employees or those not proficient with using the eTools and their associated software applications…	Click for Level of Importance	Click for Level of Difficulty
An approach that eases negative and resistive attitudes adopted from impatience and low technical abilities in using the eTool technology for aircraft maintenance…	Click for Level of Importance	Click for Level of Difficulty
A backup procedure/system for technical data in case of a system failure situation…	Click for Level of Importance	Click for Level of Difficulty
Part B: Action Items		
Please list at least three (3) Action items you think would improve implementation and use of the eTool/eTO technology in the MRO organization. For example actions which will improve the quality and the effectiveness of the eTO program not only for the people who use the eTools but for the personnel who manage it as well. Just type inside the box and be as detailed as you wish. The box will expand as you type. Please feel free to type as much as you need/want. If you have more than 3 action items simply continue to type below and onto the next page as necessary.		
`		
EXAMPLE: I think training during in-processing into the MRO will help users to adapt more quickly to the using the technology.		
1		
2		
3		

Dear Mr. Toves,

This template was my own creation so please feel free to model your own using this questionnaire in any way that will help you achieve your goals.

Best wishes in your work.
Dr. Graf
Linnaya Graf, PhD
XXX-XXX-XXXX
Owner, PrePEAR.com, LLC

MPH Faculty & Instructional Mentor, Liberty University
Doctoral Faculty, University of Phoenix
On Wed, Feb 19, 2014 at 10:04 PM, Peter R Toves <rocky_1959@msn.com> wrote:

Dear Dr. Graf,
During my research to explore the use of a "force field analysis, I was referred to look at your outstanding dissertation. "An exploratory study of factors that impact the application of empirical research to practice from the perspective of family violence prevention workers. In doing so, I was inspired to complete my data collection process with a questionnaire like yours. That said, I respectfully ask permission to use your questionnaire as a template to develop my own.
Thank you for your help in advance

Peter R. Toves
Walden University, student

Appendix D: Pilot Study Invitation Letter

[Date]

Dear [name]:

Hello, my name is Peter Rocky Toves and I am a doctoral student in the Walden University, Management and Technology PhD program. I am writing to request your consideration in participating in an important *pilot* study designed to validate an interview tool, protocol instructions, and questionnaire which will be used to increase understanding of the critical success factors in the implementation of e-maintenance in aircraft maintenance organizations.

You were selected to participate in this *pilot* study because of your professional working experience in some area of aircraft maintenance (i.e. TODO, senior leadership, and experience eTool technology user). I realize your time is very valuable and your job is demanding, but I hope you will consider providing your valued and important feedback by participating in this study.

There is no direct compensation for participation in this study. However, the information learned during this study can benefit technology acceptance by improving the data collection tools and procedures, which will assist in clarifying the needs and experiences of senior leaders, front-line managers, and maintainers from the aircraft maintenance community. Individuals who work directly within the field are a population with valuable experiences and perspectives to share. Therefore, it is critical for the researcher to ensure that the tools and techniques for conducting this research are refined and established as appropriate.

For this study, participants are being asked to complete an open-ended interview and provide feedback on the interview questions and process i.e. instructions or protocol. Interviews will be accomplished in person and participation is completely voluntary therefore, you may cease participating at any time. For the next phase, feedback relative to the clarity and understandability of the instructions and interview questions will be requested. This will give the researcher insight to better refine or reword unclear questions and address potential awkward instructions. Finally, the questionnaire instrument will be distributed for completing then face and content validity feedback will be requested (appearance, representativeness of its elements, accuracy and connection among the interview questions).

All information collected during this pilot study will be completely confidential. As the primary researcher, contact information, will only be used by me to send out initial requests and complete interviews. Immediately upon interview completion, all possible identifiers will be destroyed immediately. All data will be assigned an alphanumeric code, which cannot be linked to any personal identifiers. If you have questions or comments regarding this study you can contact me at, XXXXXXXXXX. In addition, if you are interested in finding out the results of this study, a summary report will be available on demand. Thank you in advance for sharing your experiences and providing your valued feedback.

Appendix E: Interview/Observation Consent Form

Thank you for considering participation in the research study of, evaluating success factors critical in implementing e-maintenance in aircraft maintenance repair and overhaul organizations (MRO). This research study will be conducted by Peter Rocky Toves, a doctoral student at Walden University with Dr. David Gould as research advisor. Mr. Toves invites senior leaders (group commanders [GC] or equivalent), TODOs (program managers), and aircraft maintainers to be part of this important study. This form is part of the informed consent process, which allows potential participants complete disclosure of the intent and procedures of this research before agreeing to take part.

Background Information:

Electronic technical orders (eTO) via eTools (computers) is a complete paradigm shift from a more than 65 yearlong maintenance concept. ETOs and eTools promised to transition the AF war-fighter into the twenty-first century and a paperless maintenance environment. Yet, after more than a decade and with the technology available, less than sixty percent of full technology implementation has been achieved across all maintenance organizations combined. The reason for this is unknown however; the fragmented state is impacting full transition to a digital end-state and costing additional dollars in sustaining multiple technical manual formats annually.

Purpose:

The purpose of this qualitative case study is to identify and explore the socio-technical factors that inhibit an effective transition from a paper-based TO system to an electronic-based system for aircraft maintenance within your organization. This will be accomplished by collecting information from interviews, observations, documentation and questionnaire. Participants include TODOs, GC, and maintainers. Interviews will be used to collect information regarding the opinions, perceptions, and attitudes about this research topic. Observations will be documented to get a holistic understanding of the impact of issues (if any) associated with the use of the technology to perform maintenance.

Documentation will be reviewed to determine whether there are gaps between what is written and what is interpreted between the managers and maintainers within the organization. Questionnaires will be used to capture and analyze the perceptions of participants based on key data combined from previous data collection events.

Procedures: A 4-phase process.

If you agree to take part in this study, you will be asked to participate in a 4-phase data collection process.

- Person-to-person interviews lasting no longer than one hour. The purpose of the interview will be to explore your opinions and perceptions about the research question related to the study. This will be accomplished during off work hours.
- Observation period, non-interactive and conducted during aircraft maintenance lasting no longer than 30 min. This will be to observe how the technology is used and to identify any external or internal influencers impacting technology usage.
- Follow-up interview/member checking, the purpose of this phase will be to answer likely questions developed during the observation and clarify any other collected (interviews) information for accuracy.

- Documentation will be examined for potential conflicts between internal policy and procedures, interpretation of guidelines between staff members and workers, and or potential training shortfalls (Documentation will only be reviewed in the Quality Assurance office during TODO interview).
- Questionnaire, sometime after the data is captured, the researcher will contact you to fill out a questionnaire and rate the most important issues/factors based on the aggregated information collected.

Total amount of participation of all phases should be no more than two hours for each participant. Interviews will be conducted off hours and observation sessions (non-interactive) will be based on your schedule and convenience but within the timeframe of the allotted study. There will be no observations conducted for the GC or TODOs. This is because GC will only be needed for interviews and TODOs for interviews and program documentation. However, all participants will be issued the questionnaire.

Voluntary Nature of the Study:

This is event and completely voluntary. Everyone will respect your decision of whether or not you choose to take part of the study. If you decide to join the study now, you can still change your mind during or after the study. You may stop at any time.

Risks and Benefits of Being in the Study:

This study is voluntary; your decision will be respected whether or not you choose to take part of the study. Refusing or discontinuing participation involves no penalty or risk to your employment. Therefore, there are no known risks associated with this study. Participating in this study would not pose a risk to your safety, well-being or job security. In addition, all personal information will be confidential and destroyed once the research is complete. The benefits gained from this study should assist in improving current and future technology implementation because the research focuses on real-life user concerns. The findings can potentially help to formulate user defined technology implementation and intervention strategies. This will assist in mitigating resistance to change and strengthen technology acceptance. A formal research study will provide leaders with a lens through which to explore efficient organizational alignment, strategic planning and especially, the socio-technical concerns that emerge as a result of technology insertion.

Payment: Participants will be given a lunch card if they agree to be part of the study.

Privacy:

To ensure privacy, all participants will be assigned unique numerical identifiers and any personal identifiers will be deleted from all personal correspondence. Contact information will only be used to send out initial requests and complete interviews and questionnaires. All physical information whether electronic or in paper will be secured in a locked file cabinet or safe. Although, your participation must be authorized, the research team will ensure details and specifics are kept in the strictest confidence and control. Your personal information will not be used for any purposes outside of this research project. Also, the research team will not include your name or anything that could identify you in the study reports. All contributions and personal information such as name age, contact information, experience and other personal private data will be aggregated into the final report and will be kept in a personal hard drive in a safe for 5 years as required by the university.

Note: This study is supported by the DoD and, as such, DoD personnel will have access to research records in order to ensure the protection of research subjects.

Results:

Results of this study, a summary report will be available at:
https://eis.aetc.af.mil/hq/A47/A4M/A4MM/A4MMP/TODO/Forms/AllItems.aspx.

Contacts and Questions:

Please forward any questions you may have now or later, to the researcher via e-mail at X X X X X X . If you want to talk privately about your rights as a participant in this research study, you can call Dr. Leilani Endicott, a Walden University representative, who can discuss this with you. Her phone number is 1-XXX-XXX-XXXX, extension XXXX. Walden University's approval number for this study is 08-12-14-0127632 and it expires on August 11, 2015. The researcher will give you a copy of this form for your record. Thank you in advance for sharing your experiences and providing your valued feedback.

Statement of Consent:

I have read the above information and I feel I understand the study well enough to make a decision about my involvement. By signing below, I understand that I am agreeing to the terms described above.

Printed Name _____

Date of consent _____

Participant's Signature _____

Researcher's Signature _____

Position (X one)						
Contact number	TODO		Mechanic		MGMT	
Email address						

1. Which of the following falls within your age range?	20-40	40-50	50-60	60+
2. Which of the following ranges best describes your years of experience in the AF aircraft maintenance field?	1-5	5-10	10-15	15+
3. Which of the following best describes your experience in using paper technical data to perform aircraft maintenance?	1-5	5-10	10-15	15+

4. Which of the following best describes your experience in using digital technical data to perform aircraft maintenance?	1-5	5-10	10-15	15+
5. Which of the following best describes your education level?	High School	HS & some college	College Degree	College Degree +

Appendix F: Open Invitation Letter

[Date]

Hello, my name is Peter Rocky Toves and I am a doctoral student in the Walden University, Management and Technology PhD program. I am writing to request your consideration in participating in an important study designed to explore factors critical to the implementation of e-maintenance in AF maintenance organizations. *Participants* needed for the study will be aircraft maintenance workers, group commanders (or equivalent) and technical order distribution officers.

The *objective* of this research will be to exploit and evaluate factors critical to the implementation of e-maintenance in aircraft maintenance organizations. Its focus will be to develop a socio-technical understanding on why the shift to eTools and eTOs is not fully implemented after more than a decade. This will be accomplished by exploring how the organization perceives the technology's value, management, and use in the workplace. The value of this research design will serve to understand actual problems impeding full implementation, intern to help organizations determine potential intervention and or planning strategies that can improve current and future technology employment across aircraft maintenance organizations.

The case study will *explore* the perceived value, use, implementation, and management of the eTool technology based on the perceptions of the organization's internal users, managers, and implementers from the one maintenance organization. The researcher will accomplish this using interview, observations and questionnaire. Additionally, the researcher will review operational guidelines and other documentation, which may identify potential conflicts between management, user, and management interpretations. Individuals who work directly within the field are a population with valuable experiences and perspectives to share. Therefore, it is critical that all of the voices from senior leaders to front-line employees are heard when making decisions, planning, and managing and employing large scale technology initiatives.

The *implications* for social change of this study should provide an empirical roadmap that leads to an improved understanding in managing technology-enabled change and facilitates more efficient use of scarce resources. Moreover, will help to transform aircraft maintenance practices to a paperless environment and modernizes the twenty-first century maintenance repair and overhaul organizations within the DOD. .

Sincerely,

Peter Rocky Toves

Appendix G: Observation Protocol

Observations will explore the value-added of technology based on the perceptions of the organization's internal users and managers from one aircraft MRO organization. Observations will help to conceptualize the perceived value of the technology in the workplace in an effort to exploit both contributing and inhibiting factors that influence social change and technology acceptance.

Observations will be non-interactive and conducted during aircraft maintenance activities (low flying hours) lasting no longer than **30 min**. Observations will take place when aircraft poised for periodic inspections or down for repair and within the maintenance hangar complex between 8AM-7PM. In an effort to help further explain the dimensions of the observations for the proposed research study, follow-up interviews may be conducted (as required). However questions will be formulated (if any) during the observation period.		
Points observed as participants work with the technology:	**Objective:**	**Who:**
1. Perceived usefulness	To understand whether users perceive the technology as value added in lieu of paper	Technology users/ aircraft maintenance workforce. Data will be collected on 17 participants or until saturation occurs.
2. Perceived ease of use	To understand if the technology available is simple and non-complex in functionality	
3. Computer self-efficacy	To understand whether there may be a training shortfalls and or computer skill-set issues	
4. ETool (laptop) Software	User friendliness (ease of navigation, etc.)	
5. Technology Architecture/set up	To understand whether there is reasonable access to the data, it reliability, and user friendliness.	
6. Follow-up	Answer likely questions developed during the observation and clarify any other collected information for accuracy.	
Notes.		
Access: Access will be authorized by the deputy director of maintenance overseeing aircraft maintenance operations. **Method:** Information found relevant to potential factors for the phenomena will be captured and reported as part of the findings. **Storage:** Field notes will remain secure and in the custody of the researcher until di-identified and transcribed. **Time:** Observations will take place immediately after the interview sessions. This will be the best opportunity to allow understand potential issues captured during the interview session.		

Appendix H: Documentation Protocol

Documentation should be accessible from the Quality Assurance office responsible to evaluate, inspect, oversee, and enforce the quality of all maintenance programs and activities outlined in MRO Instructions (AFI 21-101, 2010). Documentation will be examined for potential conflicts between: policy and procedures, interpretation of guidelines between staff members and workers, and or potential gaps in training shortfalls.

What documents will be reviewed:	**Definition**
7. Organizational operating instructions (OI) and local policies.	OIs are guidelines specific to the business practices performed by the particular organization. OI's are customized to meet the needs of the particular function and environment in which the organization is located.
8. Command X directives and policies	Command directives are a higher organization which oversees and provides guidance or specific instructions for units within their scope of authority
9. Program technical manual 00-5-1	00-5-1 is a compressive technical order that dictates in detail how the technical order program will be managed.
10. Technology implementation technical order 33S-Etool	33S-etool is a technical order in which the AF uses to set-up the technology infrastructure for the users
How documents will be reviewed.	
Access: Digital access will be granted by the technical order distribution officer in charge of overseeing the program. **Method:** Information found in conflict, unclear or relevant to a potential factor for the phenomena will be printed, highlighted and reported as part of the findings. **Storage:** All digital and or paper data reviewed will remain secure and in the custody of the office of primary responsibility, in this case the TODO office. **Time:** Documentation review will take place immediately after the TODO interview. This will be the best opportunity to allow the TODO demonstrate potential issues within the guidance and documents that could have been refreshed during the interview secession. **Length:** Total time for review will take approximately 1 hour.	

Appendix I: Organizational Consent

EIF Student Member: Peter R. Toves
Current Class: Dissertation: In the pursuit of the degree of Doctor of Philosophy in Applied Management and Decision Sciences
Topic: Evaluating Critical Success Factors to Implementing Large Scale Technology Programs in US Air Force Organizations
EIF Project #: *(assigned by EIF secretary)*

Summary of Research/Talking/White Paper Proposal:

- *Problem statement, or problem being addressed*:

For more than a decade, the United States Air Force has been transitioning from a paper technical order maintenance practice to an eTool (laptop) and electronic technical order (eTO) environment. Technical orders are aircraft specific instructions (manuals) used to repair USAF aircraft. This paradigm shift is expected to eliminate over 100,000 types of paper manuals, 3 warehouses and save American tax-payers hundreds of thousands of dollars in printing, shipping and packing costs annually. The problem is that the use and implementation of eTool/eTO technology is fragmented across most AF bases. Although eTools are available, units are utilizing less than 60 percent of their resources (Teate, 2012). Resistive behaviors could be inhibiting full implementation resulting in, significant budget impacts, data currency issues, and dual sustainment of both electronic and paper data sources. Kim (2009) believes that user resistance can be due to bias or preference to stay with the status-quo. Lewin's (1947), 3 stage change model (unfreeze, change, refreeze) suggests that organizations are stuck in the change or transition stage.

- *Potential A4/7 benefit or application*:

The significance and value of this study to the AF and potentially others cannot be understated. The research is important because the findings will be based on user defined factors that can be used to strategize future technology-enabled change approaches. If acted upon, user defined approaches will have the potential to mitigate resistance to change and strengthen technology acceptance. This assumption is based on the user expectations (perceived usefulness), attitude, (subjective norms) and skill-sets (computer self-efficacy) that drive, intension, acceptance, and behaviors (Davis & Venkatesh 2000, Davis 1989, Kwahk, 2008). Moreover, the ability to frame user expectations within a change management approach for technology acceptance is rare for most all AF technology projects. Thus, the proposed research should result in an empirical roadmap that provides leaders the ability to make informed decisions when strategically planning large scale technology projects. In addition, it will enable social change by positively contributing to the effective transformation of technology-enabled change that modernizes the 21st century USAF maintenance practices.

- *Way ahead timeline & expected outcomes:*

Based on the approval to conduct the research by the Walden University Dissertation Committee, the researcher estimates to complete NLT 3 months after approval and unit consent. The outcome is expected to provide real data in which the AF can utilize for implementation strategies for future IT projects.

Anticipated resources/support needed:
20 participants from the 12FTW. 2 TODOs, 2 Group Commander or equivalent, 16 maintainers, A4/7 letter/message of endorsement, 12th FTW letter of cooperation, 1 interview room.

Supervisory Chain Comments *(Signature ensures student has informed their supervisor of the proposal being submitted to EIF)*: Reviewed this proposal and support the research/paper Mr Toves plans to conduct.
Signed
Arthur L. Johnston, Jr., A4MMP Section Chief
7/9/2013
x

Comments: Signed by: AGUILAR.JOHN.A.1231117780

Peter "Rocky" Toves
AETC Command TODO/
Digital TO Program Manager

-----Original Message-----
From: HAMM, ROBERT E JR GS-14 USAF AETC 12 FTW/MX

Sent: Monday, July 22, 2013 11:49 AM
To: SISSON, BARBARA A ES-00 USAF AETC AETC/A4/7; WEST, ROBERT J GS-15 USAF AETC 12 FTW/MX
Cc: SLOAN, JEOFFREY D Col USAF AETC AETC/A4M; AGUILAR, JOHN A GS-14 USAF AETC AETC/A4M; BRYANT, ANTHONY W Capt USAF AETC AETC/A4/7E; MARTINSON, DAVID A Col USAF AETC AETC/A4/7D2; BERLETTE, CRAIG A Col USAF AETC AETC/A4/7D; POUNDS, TONY Col USAF AETC AETC/A4/7D; ESTEP, LORNA B ES-00 USAF AFMC HQ AFMC/A4; GOODFELLOW, GERALD V Col USAF AETC 12 FTW/CC; GIFFORD, JAMES M JR Col USAF AETC 12 FTW/CV; DAY, LIZ GS-15 USAF AETC AETC/A4P; TOVES, PETER R GS-11 USAF AETC AETC/A4MMP; ANDREWS, ARTHUR J JR CIV USAF AETC AETC/A4MM
Subject: RE: Dissertation Proposal to Study the 12th MX

Ms. Sisson,

Please find attached, a letter from Mr. West authorizing Mr. Toves to conduct research within the 12FTW/MX. This proposed work related to electronic technical orders and e-tools is very worthwhile. We are anxious to assist any way we can. Mr. West has appointed me as POC to assist Mr. Toves. Please have Mr. Toves contact me if he needs any help at all.

Bob

Robert E. Hamm Jr.
Deputy Director of Maintenance
12FTW/MX
Randolph AFB, TX 78154
D487-8650
Comm210-652-8650
Cell 210-845-7271
-----Original Message-----
From: SISSON, BARBARA A ES-00 USAF AETC AETC/A4/7
Sent: Thursday, July 18, 2013 4:41 PM
To: WEST, ROBERT J GS-15 USAF AETC 12 FTW/MX
Cc: HAMM, ROBERT E JR GS-14 USAF AETC 12 FTW/MX; SLOAN, JEOFFREY D Col USAF AETC AETC/A4M; AGUILAR, JOHN A GS-14 USAF AETC AETC/A4M; BRYANT, ANTHONY W Capt USAF AETC AETC/A4/7E; MARTINSON, DAVID A Col USAF AETC AETC/A4/7D2; BERLETTE, CRAIG A Col USAF AETC AETC/A4/7D; POUNDS, TONY Col USAF AETC AETC/A4R; ESTEP, LORNA B ES-00 USAF AFMC HQ AFMC/A4; GOODFELLOW, GERALD V Col USAF AETC 12 FTW/CC; GIFFORD, JAMES M JR Col USAF AETC 12 FTW/CV; DAY, LIZ GS-15 USAF AETC AETC/A4P; TOVES, PETER R GS-11 USAF AETC AETC/A4MMP; ANDREWS, ARTHUR J JR CIV USAF AETC AETC/A4MM
Subject: Dissertation Proposal to Study the 12th MX

Dear Bob,

Thanks for recently looking over the draft eTools research study (attached) that Mr. John Aguilar sent to you and Bob Hamm, which was proposed by Mr. Rocky Toves of our A4M Division.

Mr Toves proposes to conduct this research study at your maintenance facility, so your willingness to voluntarily support this research study is very much appreciated. Our preliminary review of Rocky's proposal leads us to believe that his eTools research study may be very beneficial to the AETC A4/7, our Wings as well as to AF logistics enterprise in general. Rocky is pursuing this research study as part of his Ph.D. pursuits & is following the guidelines of a new voluntary program we've instituted called the AETC A4/7 Education Integration Forum (EIF).

By way of background, I began the EIF here in AETC A4/7 as an informal support group for A4/7 folks who are pursuing or who've already achieved a formal higher education. Our goal is to offer potential areas of study for students as well as to leverage this fresh intellectual capital especially in these times of shrinking resources to improve our organizational processes, help resolve problems, & directly enhance our overall A4/7 knowledge management processes.

In particular, Mr. Toves' study will evaluate the success factors critical to implementing large scale technology in AF organizations specifically, electronic technical orders (ETOs) & eTools. His goal is to develop an understanding of the social factors that influence technology acceptance in a maintenance organization. This work should prove helpful to the AF because, after more than a decade of trying, less than 60% of eTOs & eTools have been successfully implemented across our maintenance organizations. Rocky plans to conduct this research through interviews, observations, survey & by reviewing local documentation. His aim is to develop information based on real-life human factors that may potentially be used as a road map to improve technology implementation in the future.

Our Directorate chain of command, from Mr. Toves to me, has endorsed this study, which he will be conducting during his own personnel time since civilian personnel are not authorized to work on personal educational pursuits on government time. That said, we know you have manpower challenges at this time & we hope you can find a way for your personnel to volunteer to participate in this study while still complying with all civilian personnel time & attendance rules.

Attached please find a draft letter of cooperation for your consideration. Please revise it as you see fit & return the letter to Mr. Toves if you choose to allow your personnel to take part in this study. Once Mr. Toves receives your letter of cooperation, he will seek final approval from his University's dissertation committee to proceed & will then contact you with more details about this study. Thank you, Bob, as always for your consideration of support for this worthwhile intellectual pursuit!
Wr,
Barbara
Barbara A. Sisson, P.E., SES
Director, Logistics, Installations
& Mission Support (A4/7)
Air Education & Training Command (AETC)
Joint Base San Antonio-Randolph AFB, TX
Comm'l 210-652-4568; DSN 487-4568

Appendix J: USAF HRPO Review

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON DC

SEP 2 6 2014

MEMORANDUM FOR WALDEN UNIVERSITY
ATTN: PETER TOVES

FROM: AFMSA/SGE-C
Research Oversight & Compliance Division
7700 Arlington Blvd. Ste. 5151
Falls Church, VA 22042-5151

SUBJECT: Human Research Protection Official (HRPO) Review of **FSG20140028H.**

References: (a) 32 CFR 219, Protection of Human Subjects
(b) 10 USC 980, Limitation on Use of Humans as Experimental Subjects
(c) AFI 40-402, Protection of Human Subjects in Research

In accordance with HRPO review requirements of Reference (c), the following protocol has been reviewed and approved:

FSG20140028H "Evaluating Success Factors in Implementing E-Maintenance in Maintenance, Repair and Overhaul (MRO) Organizations".

To assist in the proper accomplishment of this study, please ensure compliance with the above references, including Reference (c), as it pertains to annual progress reports, final reports, proper maintenance of records, and the application of written informed consent to all study participants.

JAMES BENJACK, Lt Col, USAF, BSC
Director, Research Oversight & Compliance Division