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Aircraft Maintenance Organizational Structure Changes an Antecedent Model

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AIRCRAFT MAINTENANCE ORGANIZATIONAL STRUCTURE CHANGES: AN ANTECEDENT MODEL

THESIS

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Abstract

Air Force leadership has ordered the development of an Enterprise Resource Planning (ERP) system called the Expeditionary Combat Support System (ECSS). Many current jobs and positions will be streamlined, restructured or removed, while some will certainly be created to handle the new requirements associated with ECSS. The structure of the Air Force is certain to change with the implementation of ECSS. The Air Force has used many maintenance organizational structures since its inception in 1947. The focus of this research is to analyze past organizational structures to define key factors that affect organizational change. A case study style methodology was applied to eight periods of maintenance-related organizational change. Strategic initiatives, information and maintenance-related technology advances, change and project management practices were evaluated for relational affect. The researcher found that the strongest relational variables leading to organizational structure change were force-size change, budget change and major conflict occurrence or cessation.

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To my wife and daughters

Acknowledgments

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AIRCRAFT MAINTENANCE ORGANIZATIONAL STRUCTURE CHANGES: AN ANTECEDENT MODEL

I. INTRODUCTION

Background

The United States Air Force is a large and diverse organization composed of many business and non-business related activities. Since its inception in 1947 and the proliferation of information technology, the USAF has developed and implemented hundreds of single point, single interface, stand-alone systems. Each of these systems has met a specific purpose, with varying degrees of success. As the technology has developed and the speed of operations has increased, the need for a comprehensive, cross-functional, integrated system has emerged. This system is known as an Enterprise Resource Planning (ERP) system. An ERP is a commercial technology solution that integrates financials, manufacturing, distribution, and other business (and non-business) functions in a single technology solution. This system will bring integrated, seamless information flow across the USAF by utilizing a comprehensive set of interconnected modules. A key benefit of an ERP system is that it will provide a standardized business process model with tools available across the entire organization, regardless of program or site.

Although an ERP system would seem like a panacea for all the information woes encountered in any organization. The conceptualization, development, governance and implementation of a single solution for an organization the size of the USAF are a tremendous challenge. The Air Force currently uses over 700 information technology systems, many of which are duplicative and stand-alone. Some of the problems associated with this glut of systems include a multitude of metrics with competing goals, non-standard reporting, credibility issues, and time inefficiencies. In addition, there is limited visibility of assets across the supply chain. It is nearly impossible to track, in a timely manner, what parts are in the pipeline or available at any specific location. This lack of visibility makes planning for maintenance or resupply more challenging than it could be.

The effective use of an ERP will bring a multitude of efficiencies to the USAF. With the streamlining of so many activities, many manpower positions may no longer be required and may be realigned or, in some cases be removed. This force reduction will certainly drive the organizational structure of the Air Force to change. The Air Force is in the development stage of implementing its own ERP solution called the Expeditionary Combat Support System (ECSS).

The Department of Defense has seen its congressionally approved annual budget reduced significantly in the last several years. With increasing budgetary pressure, the Air Force leadership has initiated a force wide call to be more efficient in all facets of operation called Air Force Smart Operations for the twenty-first century (AFSO21). The logistics leadership has thus implemented a campaign called “eLog21”. This campaign is directed at making Air Force logistics leaner, lighter and more efficient. Part of the eLog21 campaign is the implementation strategy behind ECSS. The Air Force estimates savings of more than $644 Million over the Fiscal Year Defense Plan (FYDP), with an additional $320 Million in net savings within the FYDP. It also estimates more than $100 Million annually beyond the current program (ECSS Fact Sheet, 2007).

In March 2005, the Air Force issued its request for quotes to the commercial ERP development sector. Oracle Corporation and SAP Public Services, Inc. were the primary bidders. Oracle Corp won the contract because it was able to propose full compliance as specified in the request for proposal, and was deemed the "best value".

Problem Statement

The Air Force is beyond the conceptualization stage of its ECSS solution. The structure of the Air Force is certain to change with the implementation of ECSS. Many current jobs and positions will be streamlined, restructured or removed, while some will certainly be created to handle the new requirements associated with ECSS.

Organizational change is nothing new to the Air Force. Since its inception in 1947, there have been a myriad of organizational structures used by the Air Force. Many lessons have been learned from each transformation to the next. Properly identifying the main recurring factors and antecedents of these changes, and measuring the positive or negative effects of these changes is of great value.

Research Question

The main focus of this research is to answer the following research question; "Which factors lead to large scale organizational changes in the Air Force?" By identifying these factors, decision-makers will be better prepared to optimize the organizational changes associated with ECSS.

Investigative Questions

In order to properly direct the research and answer the research questions, the following investigative questions and sub-questions were explored.

1. What have been the significant organizational changes undertaken by the Air Force, since 1947, specifically in the field of maintenance?

2. What were the driving factors or antecedents leading to each organizational change?

    A. How are the changes similar?

3. What was the outcome of each structural change?

    A. Why were the changes successful or not?

4. Was there a pattern to the series of organizational changes?

    A. How closely does the pattern follow the "double helix" cycle of organizational evolution?

Scope/Limitations

The research is conducted by studying the history of organizational structure changes in the Air Force. This study focused on changes related to maintenance command and control. Historical information is used for case-study style analysis. Some data pertaining to degree of impact for these factors may not be available for evaluation.

Methodology

A case-study style methodology grounded in business process change theory is used to create a matrix of key factors and antecedents of organizational structure change events. The case-study matrix will quantify and stratify the most significant causal factors involved in facilitating these organizational changes. Furthermore, analysis of these findings attempts to discover if an identifiable cyclical “double helix” type trend exists in the cycle of structural changes.

The Logistics Transformation Office (LTO) AF/A4I Directorate of Transformation is the office of primary responsibility for the blueprinting and conceptualization of ECSS. The findings of this research are provided to the LTO to aid in the successful planning and implementation of ECSS related organizational structure change decisions.

Summary

Faced with reduced budgets and the need to increase efficiencies the Air Force is implementing its own ERP system called ECSS, which will provide information support to all facets of operations in a single integrated technology solution. ECSS will take the place of over 250 legacy information systems, and provide seamless information interface between all segments of the organization. The full implementation of this system is scheduled for the summer of 2013. ECSS is estimated to save the Air Force over $644 Million total in the Fiscal Year Defense Plan.

Once successfully implemented this ERP system will create the efficiencies required to propel the Air Force well into the twenty-first century. However, implementing an enterprise wide system of this magnitude is fraught with difficulties and highly complex coordination requirements which will certainly impact the organizational structure of Air Force maintenance. This research focuses on the key factors that lead to organizational structure change, and attempts to identify areas that the Air Force can focus on to ensure ECSS's success.

II. LITERATURE REVIEW

Chapter Overview

In order to set the theoretical lens for this research, this chapter will review the following; Business Process Change, Organizational Change and Contingency theories, business cyclicality, and enterprise resource planning efforts. These theories have wide-spread business applicability; this chapter will attempt to relate these concepts to changes in maintenance organizational structure.

BUSINESS PROCESS CHANGE THEORY

In the recent past, academics and practitioners have challenged the ways in which organizations structure themselves. Traditional models of hierarchy and control are described as pathological and appropriate for an era of stability, but inappropriate for today's quickly evolving business world. Organizational change has been called for under banners of downsizing, restructuring, and business process reengineering. These projects often engender themes of empowerment, teamwork, and customer orientation. While billions of dollars have been spent to redesign organizational business processes, including investment in technology infrastructure, consulting, and personnel, the results are uncertain at best. Some reports indicate that as many as 70 percent of reengineering projects fail. With a large amount of business process change (BPC) research available, the time is right to leverage this collective experience and isolate the key factors of success or failure (Guha et al., 1997).

While many recent studies have attempted to investigate BPC and organizational change efforts, they are mostly limited in scope. Three attributes characterize recent work in BPC. First, they are often not based on theory. This would suggest that the diverse research streams in strategic management, innovation, organizational behavior, and implementation provide only limited guidance on change efforts. Second, these studies suffer from an over simplification of variables, often isolating their scope of investigation to information technology (IT), strategic orientation, or change management. While limiting the research domain of BPC in this manner is effective in focusing the research effort, it prevents investigating phenomenon that may have a wide variety of contingency factors. Third, many recent studies look at single organizations and single BPC projects. The advantages of in-depth case studies notwithstanding, without variance or divergence in variables, it is almost impossible to interpret results in a manner that instills confidence in terms of external validity (Guha et al., 1997).

The research challenge, then, is one of leveraging existing theory and examining diverse attributes of BPC across multiple contexts. Such an approach, if accomplished through cross-case analysis, can complement theories that assume an invariant relationship between independent and dependent variables. This research attempts to examine antecedents to BPC outcomes by applying a theoretical framework that includes a wide variety of variables consistently across case studies with diverse outcomes (Guha et al., 1997).

BPC is defined as an organizational initiative to design business processes to achieve significant improvement in performance (e.g., quality, responsiveness, cost, flexibility, satisfaction, shareholder value, and other critical process measures) through changes in the relationships between management, information, technology, organizational structure, and people. These initiatives may differ in scope from process improvements that are contingent upon the degree of change undertaken to radical new process designs in each organizational subsystem and their interactions. Therefore, in any examination of BPC outcomes, consideration should be given to the environmental conditions for change and the ability of the organization to manage change in those conditions. (Guha et al., 1997).

The relationships presented in the BPC framework are based on relevant work in organizational change, strategic management, innovation, and information systems. The general thesis of this framework is that any significant business process change requires a strategic initiative where top managers act as leaders in defining and communicating a vision of change. The organizational environment, with a ready culture, a willingness to share knowledge, balanced network relationships, and a capacity to learn, should facilitate the implementation of prescribed process management and change management practices. Process and change management practices along with the change environment, contribute to better business processes and help in securing improved quality of work life, both of which are requisite for customer success and, ultimately, in achieving measurable and sustainable competitive performance gains (Guha et al., 1997).

CYCLICALITY

By examining the basic operational structure of companies—their capability chains—business genetics helps us to understand their mutation, evolution, and eventual survival or demise. Business genetics feature the industrial equivalent of the double helix (Figure 1)—a model based on an infinite double loop that cycles between vertically integrated industries inhabited by corporate giants and horizontally dis-integrated industries populated by many small innovators, each seeking a niche in the wide open space left by the earlier demise of the giants (Fine, 1998).

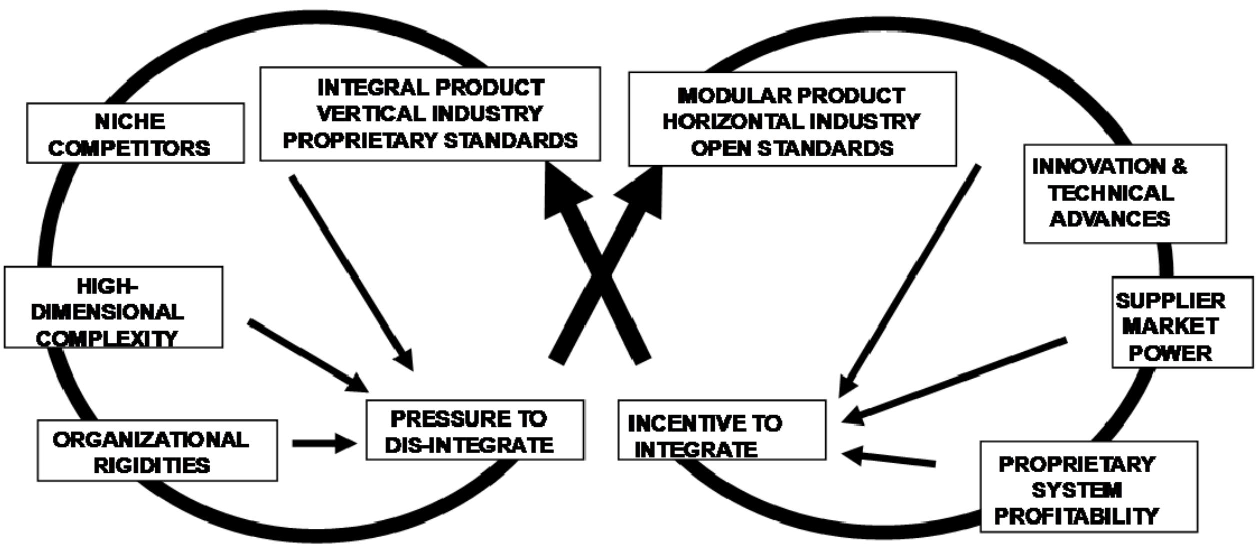

Figure 1. The Double Helix (Fine, 1998).

The business double helix illuminates how these vertical and horizontal periods determine the fate of companies, industries, and sometimes the economic fortunes of nations. Internal and external forces—niche competitors, the strain of maintaining technological parity across many products, and the organizational decay that so often afflicts market leaders—drive vertically integrated companies toward dis-integration and a horizontal industry structure. On the other hand, when an industry has a horizontal structure, the forces exerted by powerful component suppliers and by individual firms' incentives to promote their own proprietary technologies create strong pressures toward re-integration (Fine, 1998).

Forces Behind the Double Helix

When the industry structure is vertical and the product architecture is integral, the forces of dis-integration push toward a horizontal and modular configuration. The forces include: (1) the relentless entry of niche competitors hoping to exploit discrete industry segments, (2) The challenge of keeping ahead of the competition across the many dimensions of technology and markets required by an integral system, and (3) The bureaucratic and organizational rigidities that often settle upon large, established companies (Fine, 1998).

These forces typically weaken the vertical giant and create pressure toward dis-integration to a more horizontal, modular structure. On the other hand, when an industry has a horizontal structure, another set of forces push toward more vertical integration and integral product architectures. These forces include: (1) technical advances in one subsystem can make that the scarcest commodity in the chain, giving market power to its owner; (2) Market power in one subsystem encourages bundling with other subsystems to increase control and increase value; and (3) Market power in one subsystem encourages engineering integration with other subsystems to develop proprietary integral solutions (Fine, 1998).

ORGANIZATIONAL CHANGE

Organizational change is occurring at an accelerated rate. Motivated to improve performance, firms are “reengineering,” “restructuring,” “downsizing,” and “streamlining” their organizational structures (Keidel, 1995). In a survey of U.S. logistics managers, 77 percent of respondents reported that their logistics organization had undergone a major restructuring in the past 5 years. Others have also found high rates of organizational change in logistics (Lalonde and Masters, 1993).

The ultimate motivation for organizational change is the pursuit of improved organizational effectiveness, driven by a shift in the status quo among the contingency variables resulting in an adjustment to organizational structure. An understanding of organizational change requires segmentation of the process on the basis of the important elements of change, namely the magnitude, modes, motors, and drivers of change (Leenders and Johnson, 2000).

Major organizational change is “frame bending,” in that it involves a complete change from the existing orientation (Greenwood and Hinings, 1996). Movements between centralized and decentralized structures represent the most dramatic organizational adjustments. They involve movement from one end of the organizational continuum to the opposite end (Leenders and Johnson, 2000).

The mode of change can be either evolutionary or revolutionary (Miller, 1982). Evolutionary change occurs slowly, gradually, and continuously through a series of small incremental, often piecemeal changes over time. Revolutionary change occurs swiftly and affects several aspects of the organization simultaneously. Such changes occur in short bursts, which tend to be infrequent but disruptive. Radical change occurs rapidly, followed by a long period of relative stability (Tushman and Romanelli, 1985).

CONTINGENCY THEORY

A dominant message in the organizational science, strategy, and logistics literatures has been that the organization must adjust its structure to changes in the environment (Hall and Saias, 1980). Contingency theorists assert that proper alignment of organizational structure with external variables, such as environmental uncertainty and technology, will result in superior performance (Powell, 1992). For example, much of the contingency research examines the relationship between organization size, technology, or environmental complexity with organizational variables such as structure and formalization (Pitts, 1980).

Contingency theory follows Chandlers' (1962) dictum that structure follows strategy. However, recent research has found a reciprocal relationship between strategy and structure, although strategy is a more important determinant of structure than vice versa (Hall and Saias, 1980).

Structure is also influenced by the need to have a complementary alignment among the internal structural elements of the organization (Miller, 1982). Factors such as task specialization, technology, spans of control, size and responsibility of the administrative function, levels of hierarchy, and integration must be balanced among each other. The objective is economic efficiency. Proper alignment among the structural elements is necessary for optimum performance (Leenders and Johnson, 2000).

Major structural changes in maintenance organizations are made for a number of reasons. For the sake of clarity the terms driver, major influencer, and moderator are used to describe the elements involved in these structural changes.

The term driver has been used to describe each of the three pressures that culminate in a major structural change in a maintenance organization. Outside the firm, the driver consists of the dominant environmental pressures, which in turn force corporate strategic initiatives, which become the driver for a major corporate structural change. This latter change, the overall corporate structural change, is the ultimate driver of the maintenance organizational structure change (Leenders and Johnson, 2000).

A major influencer is a person or a group of people inside the company who caused a driver to change. An observed major influencer in many cases is a new chief executive officer who has a strong preference for a corporate strategic shift and/or a particular organizational structure (Leenders and Johnson, 2000).

Moderators include other individuals who were present at the time of the driver change and influence the option chosen. Moderators include consultants, business unit managers, chief financial officers and chief personnel officers (Leenders and Johnson, 2000).

ENTERPRISE RESOURCE PLANNING

The multitude of challenges faced today by global businesses is expected to grow in intensity and complexity as we go further into this century. Expanded global competition has become the norm rather than the exception, with an unprecedented number and variety of products available to satisfy consumer needs and desires. In particular, many firms have implemented company-wide Enterprise Resource Planning (ERP) systems, which are designed to integrate and optimize various business processes across the entire organization. According to Davenport (1998), the business world's embrace of enterprise systems may in fact be the most important development in the corporate use of information technology.

When properly employed, ERP software integrates information used by the financial, manufacturing, logistics, and human resources departments into a seamless computing system. A successful ERP can be the backbone of business information for an organization, giving management a unified view of its processes. Unfortunately, ERPs have a reputation for being very expensive and providing sub-optimal results, because the people who are expected to use the application do not know what it is or how it works. When ERP software fails, it is normally because the company did not dedicate enough time or money to training and managing culture-change issues. ‘‘Faulty technology is often blamed, but eight out of nine times, ERP problems are performance related,’’ says Pat Begley, senior vice president of educational services at SAP, one of the world leaders in ERP software (Parr et al., 1999).

Given the large financial commitment that an ERP project requires and the potential benefits it can offer if successfully implemented, it is important to understand what is needed to ensure a successful ERP implementation. There are two major objectives of this research. First, using a methodology grounded in business process change theory, this research focuses on a comparative case study of historical organizational changes undertaken by the logistics functions of the Air Force. Based on an extensive review, there have been no significant studies that analyze the main recurring factors and antecedents of maintenance organizational change in the Air Force Second, based on the lessons learned and case studies, this research then proposes recommendations to optimize the organizational changes associated with ECSSs implementation.

The two reasons for selecting the BPC framework for providing a systematic comparative analysis are as follows: First, since ERP implementation has come to involve changing the business processes of companies that implement such software (Kremers and van Dissel, 2000), it is important to consider that BPC theory may be helpful in explaining the outcomes of the case studies. BPC is defined as an organizational initiative to design business processes to achieve significant improvement in performance through changes in the relationships between management, information technology, organizational structure, and people (Kettinger et al., 1995). These initiatives may differ in scope from process improvement to radical new process designs depending on the degree of change undertaken in each organizational subsystem and their interactions.

As increasing numbers of organizations across the globe have chosen to build their IT infrastructure around this class of off-the-shelf applications, there has been a greater appreciation for the challenges involved in implementing these complex technologies. Although ERP systems can bring competitive advantage to organizations, the high failure rate in implementing such systems is a major concern (Davenport, 1998). A number of prominently publicized failures have underscored the frustrations and even total meltdowns that enterprises go through in implementing ERP systems. Allied Waste

Industries, Inc. decided to pull the plug on a $130 Million system built around SAP software, while another trash hauler, Waste Management, Inc., called off an SAP installation after spending about $45 Million of an expected $250 Million on the project. Hershey Food Corp. has also held SAP accountable for order processing problems that hampered its ability to ship candy and other products to retailers around a peak Halloween season (Boudette, 1999).

III. METHODOLOGY

Chapter Overview

The purpose of this chapter is to discuss the tools and techniques used to answer the investigative questions central to the research objective of this thesis. First is a summary of the problem. Second is a description of the methodology used to answer the research questions.

Research Objective

The purpose of this research is to use historical organizational changes specifically related to maintenance as case studies to identify the key factors that lead to organizational changes in the Air Force. The investigative questions and sub-questions that will answer the research question.

1. What have been the significant organizational changes undertaken by the Air Force, since 1947, specifically in the field of maintenance?

2. What were the driving factors or antecedents leading to each organizational change?

    A. How are the changes similar?

3. What was the outcome of each structural change?

    A. Why were the changes successful or not?

4. Was there a pattern to the series of organizational changes?

    A. How closely does the pattern follow the "double helix" cycle of organizational evolution?

The next step in this research process is to acquire the historical information regarding the significant maintenance related organizational changes that the Air Force has undertaken since 1947.

Data and Assumptions

The data for this research was extracted from historical information and studies concerning the significant Air Force organizational structure changes related to maintenance since 1947. The data was acquired from the Air Force Materiel Command's History Office (Wright-Patterson AFB, Ohio) with additional information coming from the Air Force Historical Research Agency (Maxwell AFB, Alabama). Each instance of maintenance organizational structure change is treated as an individual case study. These case studies provide a business process change theory assessment to identify the key factors that lead to these maintenance organizational changes. This research has been conducted and the lessons learned and observed patterns of behavior are presented to the Logistics Transformation Office to aid in optimizing the future planning and employment of the maintenance organizational structure changes resulting from ECSSs implementation.

Due to the unmatched size of the ECSS system (more than 300,000 users) it is assumed that the proposed maintenance organizational structure changes will be noticeably similar in scope to many of the historical maintenance structure changes previously experienced by the Air Force.

Research Design

In order to evaluate the historical case studies it is necessary to build certain constructs on the available data (Table 1), they include:

Table 1. Construct Definitions.

Construct Definitions		
	Construct	Definition
1	**Strategic Initiatives**	Actions directed by senior leaders in reaction to the environment or self-perception of change requirements.
2	**Information Technology**	The type of role of the technology in the reasoning behind implementing the maintenance organizational structure change.
3	**Maintenance Technology**	The type and role of the technology forcing change in structure based on emerging opportunities and constraints.
4	**Change Management Practices**	Managements role in the pattern of change, it's readiness to change and the level of participation in the change process will have positive or negative effects on the change process.
5	**Process Management Practices**	The level of management use of process measurement, tools and techniques that directly affected the outcome of the organizational structure change.

Summary

In addition to the knowledge gained through the literature review, the analysis of the case studies using the business process change theory will answer the primary research problem of identifying the key factors that have led to large scale maintenance related organizational changes in the Air Force. Furthermore, the proposed framework will be used to aid the LTOs planning and employment of future maintenance organizational structure changes resulting from ECSSs implementation.

IV. DATA ANALYSIS AND RESULTS

Chapter Overview

The Air Force’s maintenance related organizational changes are dissected into eight sections for individual case study evaluation (Figure 2) for the chronological order of these cases. Each case is established based on the predominant maintenance structure of the period. During many of the cases, multiple organizational forms were used; however, each era is evaluated based on the characteristics of the most prevalent organizational structure of the time. Furthermore, each case is broken down and analyzed based on the five criteria of the business process change model outlined in chapter three.

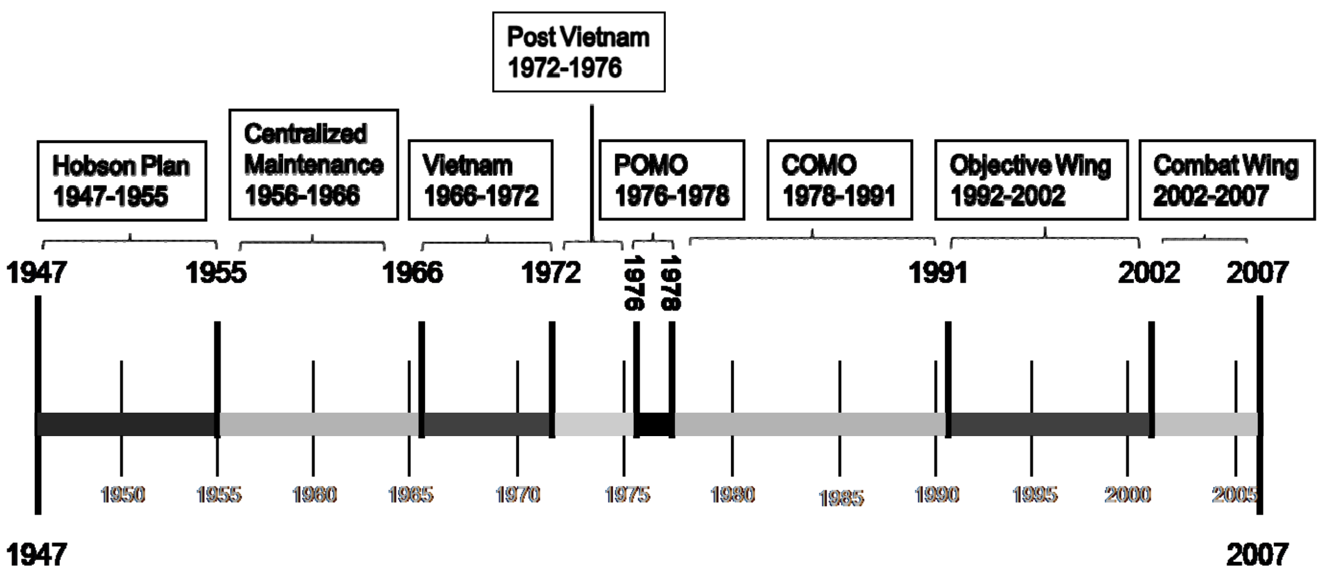

Figure 2. Organizational Change Timeline.

The first case period is from 1947 until 1955, labeled the “Hobson Plan and the Period of Uncertainty” due to the name of the Air Force’s initial maintenance organizational plan and the trial and error of structures used during the post World War II era. The next period (1956-1965) is labeled “Centralized Maintenance” because of the publication of mandatory Air Force guidance in Air Force Manual (AFM) 66-1. The third period is named “Vietnam and the Move Toward Decentralization” (1966-1972) because the high operational tempo and deployed status of USAF forces led the major commands to adapt their organizational models to meet the wartime requirements.

The period following the Vietnam conflict is titled “Post Vietnam Centralization”. From 1972-1976, maintenance organizations shifted their focus back towards centralized control and execution. In 1976, faced with force draw downs and shrinking budgets the Air Force shifted towards a new concept of maintenance, the “Production Oriented Maintenance Organization” (POMO). The next case is called the “Combat Oriented Maintenance Organization” (COMO) and covers the “Cold War” build-up period from 1978 until 1991.

After the end of the fall of the Soviet Union, the Air Force transitioned to the “Objective Wing” concept of maintenance, this period lasted from 1992 until 2002. The final case is titled the “Combat Wing Organization” and covers 2002 through 2007.

HOBSON PLAN AND THE PERIOD OF UNCERTAINTY (1947-1955)

The wartime need for specialization, coupled with the ever-increasing complexity of aircraft, made the move to specialization inevitable after World War II. This move meant the end of the old “master mechanic crew chief system.” There was a need for a new set of maintenance procedures and an organization that could better respond to the training and wartime needs (Ventresca, 1991).

Once the new Air Force was free of army domination, its first job was to discard the old and dreadfully inadequate ground army organizational structure. This was the "Base Plan" where the combat group commander reported to the base commander, who was often regular army, with no flying experience. This sometimes resulted in poorly managed aircraft maintenance operations. For example, a brigadier general commanded the 311th Reconnaissance Wing and he reported to the MacDill Air Base commander who was a cavalry colonel (Boyne, 2007).

The first Air Force Chief of Staff, General Carl "Tooey" Spaatz established a new policy, "No tactical commander should be subordinate to the station commander." This resulted in a search for a better arrangement. In October 1947, the Air Force implemented the Hobson Plan. The Air Forces' basic organizational unit became the Base-Wing. Under this plan, combat squadrons were temporarily assigned to combat groups, which were in turn assigned to a wing. The Wing Commander was an experienced air combat leader. The base support functions - supply, base operations, and medical were assigned to groups, assigned to the wing.   The group of this period was an administrative unit that consisted of nothing more than a designated commander and one assistant. The administrative unit only survived in non-combat roles. The base and the wing became one and the same unit (Boyne, 2007).

Prior to this, combat groups and support groups often carried different numeric designations. Under the new plan all carried the same. For example, the 2nd Supply Group and 2nd Medical Group were components of the 2nd Bombardment Wing. As a result of this new reorganization, all bomb groups were renamed bomb wings. This is reflected in the history and lineage of every unit. Over the years that followed, the

Hobson Plan was modified, but in the fall of 1947, for the first time, the airmen were in charge of the aircraft (Boyne, 2007).

The Hobson Plan called for crew chiefs to manage all work on an aircraft and supervise a team of mechanics in a classic, decentralized maintenance posture. The crew chief very rarely had to coordinate assistance from the field maintenance organization (George et al., 2004).

During this period, Strategic Air Command (SAC) was the leader in establishing the specialized maintenance concept. In the past, a group of maintainers skilled in all aspects of aircraft maintenance, called aircraft generalists or “crew chiefs”, would repair and maintain every inch of the aircraft. As the technology developed the aircraft became increasingly more complex. New systems were added or upgraded which severely taxed the capabilities of these aircraft generalists. This added complexity coupled with the post war force reductions persuaded the Air Force to adopt a system of specialists. These specialists were aircraft mechanics that became experts on maintenance and repair of particular systems on the aircraft, such as the propulsion systems or the avionics (Reiter, 1988).

This concept enabled maintainers to repair aircraft faster, and allowed them to become qualified much faster. The net result of specialization was increased aircraft availability to fly combat missions overseas and training missions at home-station (Townsend, 1978).

Less than a year after the Air Forces’ inception the Berlin Airlift began, it provided a valuable test of the existing maintenance structure. From June 1948 until September 1949, American and British airlift aircraft transported more than 2.3 billion tons of supplies into Russian blockaded Berlin, with more than 278,000 sorties (Launius and Cross, 1989). Lieutenant General Curtis E. Lemay, commander of United States Air Forces in Europe (USAFE) at the time, determined the crew chief system could not support the around-the-clock flying situation because of the limited number of hours a person was permitted to work. He decided that the only system capable of filling the requirements was the specialized aircraft maintenance system. Thus, specialized aircraft maintenance was born out of necessity to support the Berlin Airlift (Reiter, 1988).

In late 1949, Lemay became the Commander of SAC, and he promptly established the specialized maintenance system for all SAC units. This was the first formal move towards a centralized maintenance organization in the Air Force (Reiter, 1988). SAC Regulation (SACR) 66-12, Maintenance Management, was written to establish a functional aircraft maintenance organization with the wing-base organization, which would ensure full utilization of personnel and facilities to produce maximum availability of aircraft (Townsend, 1978). This change created four base agencies responsible for aircraft maintenance: wing maintenance control, organizational maintenance, field maintenance, and base flight and transient maintenance (George et al., 2004).

The centralized efforts of wing maintenance were directed by the wing maintenance and control agency. Organizational maintenance was responsible for flight line maintenance, periodic inspections and accomplishment of technical order compliance. Field maintenance was responsible for aero repair, communications and electronics, armament, power plant, and for providing specialists whenever needed. Base flight and transient maintenance was responsible for all base flight and transient aircraft (Townsend, 1978).

Maintenance structures changed during the postwar period from 1947 to 1955, with each command instituting its own system, but the concept of crew chief with specialized support became prevalent within the organizational maintenance structure of the operational squadron (Ventresca, 1991).

Reasons for the Change

The inception of the Air Force as a separate force coupled with the massive downsizing of the US military following World War II led to the adoption of the Hobson Plan. The traditional aircraft generalist system was no longer able to meet the needs of the quickly developing Air Force fleet; therefore the specialized aircraft maintenance concept was implemented.

Strategic Initiatives

The first Chief of Staff, General Spaatz, provided the initial vector regarding tactical command. This vision led to the development of the Hobson Plan. General Lemay applied lessons learned during the Berlin Airlift to change the maintenance organization towards the specialized concept.

Information Technology

During the earliest years there were no computers or high tech information systems. Pilots kept logs of key aircraft information, but, consolidation of this data was localized and of very little value.

Maintenance Technology

This time period saw a dramatic increase in aircraft technology. There was a shift from reciprocating engines towards a full implementation of jet powered aircraft. The role of the emerging technology had a definite effect on driving the specialist maintenance concept.

Change Management Practice

During this period, implementation of prescribed maintenance structure was optional and allowed the MAJCOMs and even base-wings to customize their structure according to their preference. Standardization and Air Force-wide consolidation efforts were not key considerations.

Process Management Practice

There was a distinct lack of standardization during the early efforts of maintenance organization. Reports were very slow and consolidation was bulky and cumbersome. With many wings using conflicting units of measure, effective comparison and evaluation of maintenance effectiveness was difficult, if not impossible.

CENTRALIZED MAINTENANCE (1956-1966)

By the end of the Korean conflict, in the mid 1950s, aircraft maintenance was evolving along a haphazard and ill-defined course. Necessity was the mother of this progress, because only during periods of national conflict had any serious thought been given to improvement of aircraft maintenance. In peacetime, prior to Korea, military aviation was a low national priority. Whenever budget cuts needed to be made, support areas such as maintenance were always among the first affected (Townsend, 1978).

In September, 1956, the first Air Force Manual (AFM) 66-1 was published. Implementation of this manual was up to the discretion of the major command. This manual established a chief of maintenance responsible for all aircraft maintenance in the wing and reported directly to the wing commander. The Chief of Maintenance was the central control point responsible for all maintenance activities. Three squadrons worked directly for and reported to the Chief of Maintenance: Organizational Maintenance Squadron, Field Maintenance Squadron, and Electronics Maintenance Squadron (George et al., 2004).

The organizational structure outlined in AFM 66-1 was not new, but it was a formalized version of existing structures. This manual was patterned after SAC manual 66-12, and was based on policies, objectives, and responsibilities contained in Air Force Regulation 66-1. It outlined provisions for an automated man-hour accounting and maintenance data collection (MDC) system. It pioneered the concept of aircraft in-commission rates, component repair standards, and aircraft scheduling objectives (Townsend, 1978).

Prior to the introduction of automated maintenance data collection, there was no real data flow from base level throughout the Air Force maintenance echelons. The only information that tended to flow between levels was unsatisfactory reports, and other bulky, and muddled monthly manual reports. The new reporting system outlined in AFM 66-1 provided for daily, weekly, semi-monthly and monthly reports throughout all levels of Air Force maintenance. The data generated by these reports aided planners and decision makers in many areas, including: procurement of spares and equipment, reliability and maintainability of equipment, manpower determination, and budgeting (Townsend, 1978).

The idea of centralized maintenance organization, standardized for the entire Air Force, had strong support from the Chief of Staff, General Thomas D. White (Reiter, 1988). In 1959, the Air Force published a revised AFM 66-1 and made compliance mandatory. The new AFM 66-1 directed the specialized maintenance concept be adopted Air Force-wide. It also moved the scheduling of all aircraft under the chief of maintenance. The MAJCOMs published supplements, which somewhat altered the organizational structure, to better meet their specific needs. The basic Chief of Maintenance organization stayed intact and this organization didn't invoke drastic changes from the previous organizational structures, it had a stabilizing effect on the maintenance organization (Harris, 1991).

The 1959 version of AFM 66-1 introduced punch cards for data collection and formalized the first use of computers for tracking maintenance activities. The added ease and increased speed, of this early information technology, greatly enhanced the information flow in the decision making process. This maintenance organizational structure had been designed for efficiency, and the economies of scale allowed the whole to be greater than the sum of the parts (Reiter, 1988). The first real test of the MDC came during the Vietnam conflict. Initially, there was no computer capability to process the MDC, the data was sent to Clark AFB for processing. Later, data processing equipment was made available in Southeast Asia to handle the inputs (Townsend, 1978).

The new AFM 66-1 maintenance management concept grew out of the need to keep pace with the rapid technological developments in weapon systems. Specialization and centralized control were established along functional lines with a single maintenance manager who was responsible for centralized control, and was responsible to the wing commander for all aircraft maintenance (Ventresca, 1991).

As directed, all commands began to use AFM 66-1 in the early 1960s. The increasing complexity of aircraft and the need for greater maintenance specialization persuaded acceptance of the centralized maintenance concept. Crew chiefs worked the aircraft on the flight line, assisted by other organizational maintenance resources, while all other specialist personnel were assigned to either field maintenance or electronic maintenance squadrons. These specialist personnel were located off the flight line and were dispatched to assist the crew chiefs as required. Communications between squadrons were facilitated through Job Control, which also maintained the paperwork and documentation. This system involved many personnel that were not directly involved in sortie generation on the flight line (George et al., 2004).

Reasons for the Change

The evolution of the now highly technical Air Force fleet demanded a highly standardized, centrally controlled maintenance organization. The rapidly developing technologies had surpassed the capabilities of the old aircraft generalist system.

Strategic Initiatives

General Curtis Lemay pioneered the vision for this era by formulating the concepts specialized maintenance concepts outlined in SACR 66-12. AFM 66-1 was the key guidance for the implementation of the centralized maintenance organization, but it was patterned after SACR 66-12. Chief of Staff, General Thomas White supplied the vision to standardize maintenance organization throughout the Air Force. General Thomas' decision to make compliance with AFM 66-1 mandatory proved to be a key step.

Information Technology

The Air Force, for the first time, had identified a standardized method for measuring maintenance effectiveness. Additionally, they harnessed the emerging power of computers by inputting and tracking these measures through the use of punch cards and computers. The system they created was called the maintenance data collection system.

Maintenance Technology

Air Force aircraft were being developed and brought into operation at a very fast pace. Likewise maintenance equipment was also coming on-line to keep these newer high tech aircraft in serviceable condition. However, there were no significant breakthroughs in this period.

Change Management Practice

The formalization of existing practices enabled buy-in from the maintenance field. AFM 66-1 had a stabilizing effect on the maintenance community and helped normalize the previously haphazard organizational structure. In 1959, the edited AFM 66-1 finally, made compliance with the centralized maintenance organization mandatory.

Process Management Practice

For the first time, the Air Force had implemented a standard set of metrics to monitor the level of maintenance effectiveness. AFR 66-1 outlined the provisions for measuring aircraft in-commission rates, component repair standards, and aircraft scheduling objectives.

VIETNAM AND THE MOVE TOWARD DECENTRALIZATION (1966-1972)

Between 1960 and 1966 the Air Force saw a drastic increase in personnel, mostly to support the expanding conflict in Vietnam. Initially, many fighter units were deployed to Vietnam on a temporary duty (TDY) basis, but soon TDY manning became permanent change of station (PCS), and the manpower situation improved, and HQ USAF placed flight line maintenance back into the tactical squadrons under Operations control. Vietnam validated AFM 66-1, although organizational flexibility was needed (Townsend, 1978).

Pacific Air Forces (PACAF) exercised the command option authorized in AFM 66-1 by publishing PACAFR 66-12, Maintenance Management. Under this supplemental guidance, the tactical flying squadron absorbed the organizational maintenance squadron and loading crews. The Tactical Air Command (TAC) also became aware that some organizational changes were needed in order to meet its tactical mobility requirements. The "TAC enhancement" program was instituted and provided for on-aircraft maintenance and for support personnel to augment the flying squadron to create an independent operating entity, as outlined in TAC Manual (TACM) 66-31 (Ventresca, 1991).

The goal of the "TAC enhancement" was "to provide the tactical squadron commander self-contained maintenance capability during periods of squadron deployments" (Townsend, 1978, 31). Thus, the era of the "squadron maintenance" concept was underway. Prior to the reorganization, the deployed fighter squadrons were augmented with support and maintenance personnel. TAC decentralized maintenance into the tactical squadrons. There was even a supply section and maintenance control unit in the tactical squadron. The Field Maintenance and Avionics Maintenance Squadrons still existed, under the control of the Chief of Maintenance, but they now only provided in-shop maintenance in support of the tactical squadron (Harris, 1991).

During the demobilization that followed the Vietnam conflict, both PACAF and TAC reverted to an AFM 66-1 compliant structure in order to consolidate resources and to reduce redundancy (Ventresca, 1991). Even though the decentralized "squadron maintenance" concept had enhanced mobility, the TACM 66-31 prescribed system could no longer be financially supported (Townsend, 1978).

Reasons for the Change

The Vietnam conflict and the high deployment posture of tactical fighter units mandated a change from the standard AFM 66-1 prescribed maintenance organization. In order for deployed squadrons to effectively meet mission requirements, the decentralized structure was the better choice.

Strategic Initiatives

During deployments in support of the Vietnam conflict PACAF and TAC saw the need to decentralize their maintenance structures. The deployed state of operations dictated that deployed operations squadron commanders needed to have control of the maintenance of their aircraft. The shift to this organization greatly enabled the deployed aircraft squadron to meet its mission. Had there been a more robust deployed footprint and indigenous maintenance complex in theater, the move towards decentralization wouldn't have been needed, but, conditions as they were mandated this transition.

Information Technology

Although, the Air Force continued to improve its record keeping and data collection procedures, there were no significant breakthroughs in information technology in this period. MDC technology became cumbersome in the deployed operational areas and hand kept records became the norm. In-theater support for information systems became a more significant priority, and future development in this area was evident.

Maintenance Technology

The Vietnam deployed squadron experience demonstrated the first shift towards on- and off-equipment maintenance practices. Technology continued to shape the way maintenance was performed. A key maintenance technology was the development and deployment of maintenance vans. The lack of established ground facilities led to need for a covered maintenance area for troubleshooting and repair. The covered, power generator equipped maintenance van was the answer (Harris, 1991).

Change Management Practice

The latitude provided to PACAF and TAC to change their organizational maintenance concept provided to be a critical leadership decision in enabling these MAJCOMs to meet mission requirements. It was clear that the normal centralized maintenance structure was too inflexible to meet the near constant deployed state of operations during this conflict.

Process Management Practice

The Air Force continued to measure aircraft maintenance performance and effectiveness. The primary concerns during this period, however, were combat effectiveness and ability to meet the wartime mission. New metrics or visions in this area were not published for this period.

POST VIETNAM CENTRALIZATION (1972-1976)

Based on the dramatic draw downs after Vietnam the Air Force felt it could no longer support the decentralized organizational structure. It directed that all commands go back to the functional organization outlined in AFM 66-1. On 1 August 1972, the Air Force published a greatly expanded version of AFM 66-1. It contained 10 volumes that covered every detail of aircraft, missile and communications equipment maintenance. It re-established an Air Force-wide centralized maintenance concept and urged each wing commander to make equipment available for maintenance when the resources are available (AFM 66-1, 1972). This presented a very different philosophy because prior guidance was predicated on maintenance actions being performed whenever the aircraft were not on the flying schedule. However, the new guidance called for the aircraft to be scheduled on an almost perpetual basis, that is, whenever they were not required to be in maintenance (Reiter, 1988). In an unprecedented Foreward written by Air Force Chief of Staff General John D. Ryan:

> Economy in the use of resources can only be achieved by balancing operational requirements and maintenance capability. This requires planning and comprehensive scheduling of equipment maintenance. Management effectiveness can then be measured in terms of maintenance accomplishments (AFM 66-1, 1972, Foreward).

Maintenance and operations were to receive equal priority in planning and execution. This was the first time that any Air Force Chief of Staff had provided definitive guidance in regards to maintenance priority in regards to operations. Daily maintenance was removed from the operational flying squadron and centralized back under the chief of maintenance, but now with equal footing with operations. Ensuring this balance was the responsibility of the wing commander (Reiter, 1988).

The new AFM 66-1 established MAJCOM evaluation teams to insure compliance with standard maintenance practices and technical data. Strict adherence to reporting and documenting maintenance actions was mandated. Rigorous Inspector General (IG) inspections and operational readiness inspections provided clear guidance that the MAJCOM option of structural flexibility in maintenance organization was no longer allowed (George et al., 2004).

The post Vietnam era is marked by maintenance consolidations at every level. With reduced budgets and emphasis on economy of effort, the Air Force directed the elimination of duplication of manpower, equipment and facilities. One example of these sweeping moves to reduce costs is the Air Forces removal of all reciprocating engine aircraft from the active inventory (Townsend, 1978).

Chief of Staff, General David C. Jones, created the Maintenance Posture Improvement Program (MPIP), to develop new ways to perform required maintenance with diminishing numbers of personnel without compromising safety standards (Harris, 1991). A separate initiative considered centralizing maintenance to support forward operating bases in wartime and to reduce airlift requirements and the logistics footprint by creating centralized intermediate repair facilities (CIRFs). During the Vietnam conflict, CIRFs were used extensively to perform heavy maintenance operations on aircraft involved in the flying campaigns. This concept expedited the return to service of aircraft by being located near the theater of operations and by utilizing economies of scale through efficient equipment and facility utilization, greatly reducing return to service times.

In another manpower maximizing effort, USAFE's Project Streamline evaluated a program of cross-utilization training (CUT) of maintenance personnel. This program was a return to the old aircraft generalist ways of maintenance. The purpose of CUT training was to train specialist personnel on the aircraft general activities, normally performed by crew chiefs (ground refueling, tire changes, etc.) (George et al., 2004). CUT Training became a staple of the Production Oriented Maintenance Organization (POMO) and later the Combat Oriented Maintenance Organization (COMO).

Reasons for the Change

The return to normalcy after the Vietnam conflict allowed the MAJCOMs to return their maintenance organizations to AFM 66-1 compliance. The economies of scale created under the centralized maintenance concept made better fiscal sense during the post-war drawdown period.

Strategic Initiatives

Chief of Staff, General Ryan set the tone for the importance of aircraft sustainability by publishing his vision for a balance between operations and maintenance. General Jones delivered his vision for maintenance to continue to meet mission requirements without compromising safety while faced with massive manpower cutbacks. He did this with his challenge of the Maintenance Posture Improvement Program.

Information Technology

Computer technology was becoming much more powerful and affordable. Aircraft maintenance data collection systems were still using punch cards, but the data was becoming more robust. For the first time, the Air Force was looking at IT as a key area to leverage against manpower and budget declines.

Maintenance Technology

The Air Force made great strides in how it maintained aircraft during this period. First, it completely phased out all aircraft with reciprocating engines. The shift to an all jet powered fleet meant a streamlining of engine repair technology and facilities. Secondly, it implemented the CUT training approach to flight line maintenance. CUT training seemed to be a step back towards the old aircraft generalist model of the early Air Force, but, actually enabled aircraft maintenance attain higher efficiencies and sortie generation rates.

Change Management Practice

The chief of staff made it clear that maintenance priority needed to be balanced with operations requirements. This communicated a significant shift in vision among Air Force leadership.

Process Management Practice

Strict adherence to reporting and documenting actions was made mandatory. The Air Force provided a clear message that compliance with maintenance directives was a key measurable and that MAJCOM and unit flexibility was no longer acceptable.

PRODUCTION ORIENTED MAINTENANCE (1976-1978)

Several factors led to the development of POMO. HQ USAF tasked TAC to develop and test a program based on concepts used by the Israeli Air Force during the Yom Kippur War in 1973 (Harris, 1991). During TACs evaluation of the Israeli maintenance system, a report indicated that the system had great possibilities in the fighter environment where rapid aircraft turnaround, sortie generation, and surge capability were essential (George et al., 2004). TAC was faced with steadily increasing sortie production requirements but had a static maintenance capability, therefore drastic change was needed. The Israeli Air Force demonstrated remarkably high sortie rates by cross utilizing skills of their available personnel. CUT training became a force multiplier that expanded sortie production without increasing personnel (Reiter, 1988).

POMO was developed to increase productivity of the maintenance work force. Actual direct production varied from about 95% for crew chiefs to about 20% for some specialists. The purpose of CUT training is to balance the workload and to have everyone producing at 60% to 70% of their available duty time. Some specialists were trained into other specialties because of workload (auto pilot to inertial navigation for example) (TAC Briefing, 1978).

Under the POMO concept, the Deputy Commander for Maintenance (DCM) retains basically the same mission responsibilities and support requirements which had been assigned under the specialized maintenance concept. POMO however, introduced the new consideration of making the distinction between on-equipment and off-equipment maintenance (Foster and Olson, 1978).

AFR 66-5 created POMO and divided specialists into two categories: on-equipment, and off-equipment. Those that were dispatched to the flight line to work on the aircraft were placed with the aircraft generalist crew chief personnel into the newly designated Aircraft Generation Squadron (AGS), instead of the old OMS. Those that stayed in the backshop to perform off-equipment maintenance were now placed in the Equipment Maintenance Squadron (EMS) and the Component Repair Squadron (CRS) (Harris, 1991).

POMO was a structure that increased decentralized execution, but decreased centralized control. It was more of a hybrid than a pure centralized or decentralized organization. However, the DCM was still in charge of all aspects of maintenance, his staff retained control of the maintenance effort; therefore POMO should be classified as a centralized maintenance concept (Johnson, 2000). There was a split in authority and responsibility between AGS and job control. The AGS owned the people, but control remained with job control. Job control had the authority to move specialists around the flight line. However, AGS had the responsibility to produce the sorties (Harris, 1991).

Within a full wing, consisting of three tactical fighter units, the AGS was divided into three separate Aircraft Maintenance Units (AMUs). Each AMU was equipped with all the maintenance skills required for generating a squadron of aircraft. The key to the

POMO concept was the cross utilization of the flight line specialists to perform many general type tasks, which, while relatively simple and routine, made up a large portion of the day-to-day maintenance activities (Harris, 1991).

During this same time frame, the F-111 ushered in a new flight-line concept, remove and replace maintenance. This concept meant fewer specialists were required for on-equipment maintenance, and resulted in less detailed technical training for many specialists. Aircraft began to incorporate self-test/built-in-test features that eliminated the need for much of the time consuming troubleshooting seen in the past. With the introduction of avionics intermediate repair shops and modular engine components, the on-aircraft maintenance became less specialized (George et al., 2004).

Reasons for the Change

The POMO concept came into being due to a need to become more efficient. Force and budgetary downsizing eroded aircraft maintenance efficiency, and flight line supportability.

Strategic Initiatives

Headquarters USAF provided a vague vision of what it expected. It tasked TAC to develop a system of maintenance patterned after the Israeli Air Force's success during the Yom Kippur War of 1973. TAC developed a system that followed the key concepts of the Israeli structure, this was called POMO.

Information Technology

The Air Force continued to find better ways to harness technology. However, no significant advances were made to maintenance IT during this period.

Maintenance Technology

This period introduced a new concept of performing on-equipment maintenance; removal and replacement of line replaceable units. This concept meant a smaller need for on-equipment specialists and less detailed technical training requirements. Aircraft also began to incorporate self-test capabilities which greatly reduced troubleshooting times.

Change Management Practice

POMO received top level support as an organizational change that would provide greater maintenance effectiveness in the era of constant downsizing. The shift toward decentralization of maintenance effort was slight and was well supported. The major changes in the distinction between on- and off-equipment support for specialists was not as well supported by the maintenance community and may be partially responsible for the lack of sustained performance gains.

Process Management Practice

The Air Force was measuring utilization rates and maintenance effectiveness as before; however, the rapid demobilization of US forces following Vietnam and continually declining budget had eroded the technical expertise of the maintenance community. Additionally, POMO encouraged the measurement of unit performance at the composite level. This meant that if a squadron had three AMUs, strong performance by two AMUs would mask the poor performance by the third.

COMBAT ORIENTED MAINTENANCE ORGANIZATION (1978-1991)

TAC had set an aircraft utilization rate (UTE rate) of 18 sorties and 25 hours per aircraft per month. General Wilbur L. Creech took command of TAC in 1978, and ordered an independent study of POMO's effectiveness. The study, which covered the period of 1969 through the second quarter of 1978, showed TAC's sortie production was in steady decline. General Creech felt the organization of maintenance was a major factor in the decline and commissioned a study to propose an organization that would fix TAC's declining maintenance performance—that concept was the Combat Oriented Maintenance Organization (COMO) (Harris, 1991).

TAC Regulation 66-5, Combat Oriented Maintenance Organization, formalized COMO as the maintenance structure for TAC in late 1978. Many aspects of the maintenance organization changed with COMO. Control became decentralized for maintenance operations. COMOs features include:

1. Each squadron or AMU does its own scheduling, and is responsible for its own UTE rate.
2. Each squadron or AMU has its own dedicated analyst to provide statistical analysis.
3. Wing score-keeping functions such as Maintenance Supply Liaisons (MSL) were eliminated and supply responsibility was decentralized to each squadron or AMU.
4. Under the new Combat Oriented Supply Organization (COSO), the squadron or AMU has its own supply support section instead of it being centralized.
5. COSO also provides for the squadron or AMU supply computer to interface with the AGS parts store.

6. The squadron or AMU does its own maintenance debrief instead of having a centralized debrief section.
7. The squadron or AMU has its own dedicated Aerospace Ground Equipment (AGE) sub-pool.
8. The squadron or AMU has dedicated phase docks for aircraft inspection.
9. Maintenance has gone from three shifts to two, with increased supervision on the swing, or “fix” shift.
10. Dedicated crew chiefs and assistants are assigned to each aircraft.
11. Job control was replaced by the Maintenance Operations Coordination Center (MOCC); AMU has authority higher than the MOCC.
12. There is squadron integrity; assigned maintenance personnel work on their squadron assigned aircraft, and squadron assigned pilots fly their squadron assigned aircraft (Harris, 1991).

The central theme of COMO was “unit pride”. The units had to not only be responsible for their actions, but to have the authority to go along with that responsibility. The results of the transition to COMO were dramatic. Sortie production, from the third quarter of 1978 to 1983, rose at an annual rate of 11.2 percent. In the first full year under COMO, 1979, TAC flew all of its programmed sorties for the first time in a decade (Harris, 1991).

In 1990, the mission capable rates increased to an all-time high of 88.4%. When considering the increased sortie rates reported by TAC between 1978 and 1990, however, consideration must be given to the fact that the period saw a changeover to more modern and reliable tactical aircraft, better technical data, and better test equipment. All could have had an impact on the increased mission capable rates (George et al., 2004).

There was consensus among senior maintenance managers that during COMO, there was a highly trained professional maintenance workforce backed up by a strong core of senior technicians. These professional maintainers saw the transition from

POMO to COMO as not a major reorganization but, instead, a realignment of responsibilities and functions (George et al., 2004)

Reasons for the Change

The COMO strategy was implemented to fix the declining key maintenance indicators (aircraft availability, mission capable rates, and sorties produced). POMO had moved the Air Force in the right direction fiscally, but, mission performance needed to improve, that's why COMO was implemented.

Strategic Initiatives

General Creech provided a clear vision of what COMO needed to be. It was very closely patterned after the POMO system, but, it infused a "unit pride" component. COMO's structure decentralized maintenance operations by providing each AMU with the authority to go along with the responsibility to meet its mission.

Information Technology

The advent of the personal computer and the proliferation of local computer terminals enabled the maintainers to eliminate the need for punch cards and instead directly input maintenance data into the computer systems. This technology advancement reduced the number of personnel required to process maintenance data.

Maintenance Technology

Reliability was being engineered into the newer aircraft, better test equipment and more accurate technical data was being introduced to improve the level of maintenance. Older aircraft were being phased out. For the first time, in the Air Force's history, budgets and personnel were rising without a significant battlefield exchange to spark it.

Change Management Practice

Buy-in by senior maintenance leadership was a key component of the implementation of COMO. Professional maintainers saw the transition from POMO to COMO as a realignment of responsibilities and functions rather than a re-organization.

Process Management Practice

A key implementation measurement of COMO was the team empowerment aspect. Under POMO, unit performance was at a macro level, whereas, under COMO each AMU was measured individually. COMO's unit pride aspect enabled the true measurement of strong or weakly performing units at the lowest level.

OBJECTIVE WING ORGANIZATION (1991-2002)

The objective wing was an effort to standardize organizations across all commands in the Air Force. The underlying concept was "one base, one wing, one commander." Chief of Staff, General Merrill McPeak had to find a way to reduce the size of the Air Force without losing combat capability. His approach was based on the following themes: strengthen the chain of command, consolidate where practical, decentralize, streamline and flatten, clarify functional responsibilities, and cut overhead (Johnson, 2000).

Two other major changes happened in the 1990s; first, the MAJCOMs were re-designated and aligned by over-arching function. SAC and TAC were functionally merged along the line of combat projection into the newly designated Air Combat Command (ACC). Meanwhile, the strategic long range air refueling assets, previously within SAC, were merged with the Military Airlift Command (MAC) fleet, into the Air Mobility Command (AMC). The second significant change was the formation of the Expeditionary Air Force (AEF) concept; this meant a significant fundamental shift in the Air Force’s mobility posture. The AEF system represented a movement away from overseas basing of “war-ready” personnel to a rapid global mobility posture of “ready to deploy” personnel locations in the United States (George et al., 2004).

At the end of the Cold War in the late 1980's, the Air Force and other services were directed to begin a 25% reduction in force structure (Deptula, 2001). This caused the Air Force to make another fundamental change to its organizational composition which resulted in what is known as the "Objective Wing Structure" (Barthol, 2005).

Under the Objective Wing the oversight of the DCM was eliminated and AMUs were placed under the operations squadron commanders. The shift was from a decentralized hybrid organization back to a pure decentralized organization (Johnson, 2000). The new structure created four groups to perform the major functions of the operational wing: Operations, Logistics, Support, and Medical Groups. Depending on MAJCOM, aircraft maintenance organizations were divided and aligned under either the Operations Group or the Logistics Group. Standard fighter wings under ACC sought to align all on-equipment maintenance within the Operations Group. Maintenance resources and those functions directly related to sortie generation were under the control of an operational squadron commander. Major maintenance and off-equipment maintenance functions remained under the newly designated Logistics Group. Strategic airlift and refueling units within AMC aligned all on- and off-equipment maintenance functions under the Logistics Group in the AGS. This was done with the intent to match functions more closely to mission requirements. The goals of the objective wing structure were to decentralize authority, remove unnecessary layers, and give field commanders responsibility for all elements necessary for mission accomplishment (Gray and Ranalli, 1993).

The objective wing was designed to align personnel around a specific "manufacturing division", the operational flying squadron, and sorties were the unit of production. The Operations Group was responsible for the entire sortie producing effort. The Logistics Group performed all major and off-equipment maintenance and other supporting logistical functions. During the 1990's, the Air Force continued to recognize the need to adapt to the changing global environment (Deptula, 2001). Corrective actions were required in response to the difficulties encountered in the first Iraq War propelling initiatives that required new operating standards. The emergence of the AEF concept in the mid-1990's intended to further decentralize authority and provide greater combat flexibility needed for the uncertain battlefield of the 21st century (Barthol, 2005).

The objective wing followed a strategy of decentralization in an effort to increase efficiency. When the Objective Wing was implemented, the Air Force had excess manpower. However, during the draw downs of the 1990s the Air Force lost a disproportionate percentage of its most skilled maintenance technicians. They quickly went from excess manpower during the draw down to manpower shortages and a dramatic loss of experience. The poor performance of the Objective Wing indicated that a high reliability system was no longer in place (Johnson, 2000).

The Objective Wing was implemented in 1992, but, by 1995 maintenance performance had declined to an alarming rate. Mission capable rates steadily declined. ACC Commander General Joseph Ralston commissioned a study to evaluate what was leading to the decreased maintenance performance. In 1995, General Ralston established the Deputy Operations Group Commander for Maintenance (DOGM). This new job was to consolidate maintenance oversight and increase expertise for maintenance discipline, integration, and accountability. The downward trend continued (Johnson, 2000).

Operation ALLIED FORCE became the first combat test for the objective wing concept with the DOGM. Maintenance performance was found lacking. Aircraft arrived unprepared for combat. Several maintenance units arrived without critical tools. Many aircraft deployed with overdue grounding maintenance actions. The long-term plan for fleet management was not evident. Operation squadron commanders demonstrated a focus on their wartime function of leading pilots, but demonstrated a lacking focus on their role of aircraft maintenance (Johnson, 2000).

The Objective Wing demonstrated a very similar pattern of maintenance to the problems addressed by General Creech, in the 1970s. ACC recognized the problems as a lack of senior aircraft maintenance leadership. It created the DOGM concept to try to counteract the downward trend in performance, however, the trend continued to decline.

Reasons for the Change

The end of the Cold War, the downsizing of the Department of Defense, and Congress's quest to reap the "peace dividend" led Air Force decision makers to implement the Objective Wing Organization. General McPeak felt the wing structure, under COMO, was too top heavy and unbalanced, therefore; the objective wing structure was created to find a better balance.

Strategic Initiatives

General McPeak had a clear vision of what needed to be done, to reduce the size of the Air Force without losing combat capability. He provided a strong leadership vision of the changes he wanted.

Information Technology

The internet age of instant information transfer was coming into its own. The existing information systems were becoming more robust and instant data transfer was enabling greater visibility throughout the Air Force's maintenance complex.

Maintenance Technology

With the exceptions of the C-17, B-2 and F-117 no new manned aircraft systems were brought online in the 1990s under the objective wing. Maintenance equipment continued to improve and technical data became more robust, however; no significant advances occurred during this period. Access to technical data did however improve through electronic files and internet based availability. The invention of the unmanned aero vehicles (UAV) was developed and fielded for the first time. UAVs have the potential to change both the operations and maintenance concepts into the future.

Change Management Practice

The implementation timing for the objective wing was tumultuous. The MAJCOMs had all been re-designated and many of their associated functions were realigned. Most experienced maintenance professionals were resistant to this change. Additionally, the force reductions of the early 1990s stripped the Air Force of a large core of aircraft maintenance experience.

Process Management Practice

Upon implementation of the objective wing concept, the Air Force eliminated the use of Air Force Regulations (AFRs). AFRs had been compliance mandatory for the past 45 years. The "semi-mandatory" Air Force Instruction became the new method of guidance. Maintenance Quality Assurance inspections were also stopped. These practices were a detriment to maintenance and safety performance.

COMBAT WING ORGANIZATION (2002-2007)

The Air Force Chief of Staff, General John Jumper commissioned a study to evaluate the existing organizational structure and to search for solutions to the declining indicators. This study was called the Chief of Staff Logistics Review (CLR). The results of this study, proposed a new universal format for aircraft wing organization known as the "Combat Wing Structure" (Barthol, 2005).

The major changes under the new combat wing structure were intended to focus on core competencies within each group (Chapman, 2002). The previously titled Support Group was renamed the Mission Support Group (MSG). Standard logistics functions of supply and transportation were merged forming the new Logistics Readiness Squadron and were transferred into the MSG from the old Logistics Group. With the sole mission of providing all aspects of aircraft maintenance, the Logistics Group was renamed the Maintenance Group (MXG). The Operations Group was relieved of all maintenance related resources and functions which were returned to the MXG (Barthol, 2005).

The intent of this structure was to standardize operations across the Air Force and enhance its expeditionary capabilities. General Jumper said the reorganization emphasizes "three core competencies." They are: "to operate air and space weapons systems, to maintain these complex weapons systems, and enhance direct mission support of our expeditionary, rapid reaction, contingency-based Air Force" (Chapman, 2002, 11) General Jumper emphasized that maintenance of air and space weapons systems is a core competency. He said, "Aging fleets and years of resource shortfalls require increased attention to the balance of sortie production and health of our fleets. This requires career maintenance professionals" (Chapman, 2002, 11).

The vision projected by General Jumper, was to allow each group to focus on the essential core competencies and refocus on maintenance policy, procedures, training, discipline, and enforcement. He sought to improve sortie production and fleet health for aircraft maintenance organizations as outlined in the CLR (Zettler, 2001). For the personnel of the organizations, members would be able to gain valuable mentorship from within the chain of command from the group commander down (Barthol, 2005).

Reasons for the Change

The combat wing organization was developed in order to improve combat readiness, enable the Air Force to focus on its core disciplines, and to better meet the needs of the Air Expeditionary Force (AEF). The objective wing concept had provided a long trend of declining maintenance indicators, and a change was necessary.

Strategic Initiatives

Air Force Chief of Staff, General Jumper provided the clear vision for the change to the combat wing organization. He wanted each group to focus on its core competencies to support "the expeditionary, contingency-based Air Force."

Information Technology

Near simultaneous tracking and monitoring of internet based and web-enabled information systems have significantly decreased the number of personnel required to support and operate maintenance information systems. However, an enterprise wide solution would greatly improve the performance and value of the data currently captured by existing maintenance data collection systems.

Maintenance Technology

High reliability systems became the norm. Significant breakthroughs in reliability centered maintenance and aircraft reliability engineering have reduced the manpower and equipment footprint for aircraft maintenance units. However, aging fleets and budgetary shortfalls balanced out the advantages gained by the technological advances.

Change Management Practice

The combat wing organization made very small changes to the maintenance organization. Buy-in from senior maintenance leadership was clear and visible throughout the implementation.

Process Management Practice

Overall balance, fleet health and sorties production metrics were identified as the most important to leadership, however; no single metric exists to measure them (Barthol, 2005). It is difficult to optimize a system where the key metrics are not standardized or easily identifiable.

COMPARATIVE ANALYSIS OF STRATEGIC INITIATIVES

When assessing the strategic initiative factors affecting the eight cases of maintenance re-organization, it is first important to discuss the left hand column criteria of Table 2. The first category is whether or not the organization, as a whole, provided centralized or decentralized maintenance control. In the early organizations, it was very evident which type of control system was in-place, however, from POMO on the organizations displayed more complex structures with both centralized and decentralized concepts. For the research, an organization is considered centralized if the wing's senior maintenance authority (chief of maintenance, deputy chief of maintenance, or logistics group commander for example) had oversight in the decision making related to maintenance activities. Conversely, an organization is considered decentralized if the senior maintenance authority did not have direct decision making authority over all maintenance activities.

Major conflict is self-explanatory (Korea, Vietnam, the Cold War, DESERT STORM, and the Global War on Terrorism were all considered). Whether or not the Air Force faced a trend of personnel increase or decrease during the inception of an organizational change are the criteria for the force downsizing column. Likewise, the budget trend category reflects whether the Air Force budget (based on 2008 dollarization of spending) was increasing or decreasing at the inception of the change. The case studies revealed that the chief of staff set the tone for most organizational changes with a clear vision of what was going to be done.

Table 2. Strategic Initiatives Matrix.

	The Hobson Plan and the Period of Uncertainty (1947-1955)	Centralized Maintenance (1956-1966)	Vietnam and the Move Toward Decentralization (1966-1972)	Post Vietnam Centralization (1972-1976)	Production Oriented Maintenance Organization (1976-1978)	Combat Oriented Maintenance Organization (1978-1991)	Objective Wing Organization (1992-2001)	Combat Wing Organization (2002-2007)
Centralized or Decentralized	Decentralized	Centralized	Decentralized	Centralized	Centralized	Decentralized	Decentralized	Centralized
Strategic Initiatives								
Major Conflict	Yes	No	Yes	No	No	Yes	No	Yes
Force Downsizing	No	Yes	No	Yes	Yes	No	Yes	Yes
Budget Trend	Up	Down	Up	Down	Down	Up	Down	Down
Leadership Provided Clear Vision	No	Yes	No	Yes	No	Yes	No	Yes
Pre-Change Metrics: Up or Down	Down	Down	Up	Down	Down	Down	Up	Down
Post-Change Metrics: Up or Down	Down	Up	Down	Down	Down	Up	Down	Down

The pre-change and post-change metrics criteria are based on the leading maintenance indicators of the era. The pre-change metrics are the leading metrics indicating maintenance performance prior to the change. A rating of "Up" means that the metrics indicate a satisfactory level of performance from the system of maintenance at the time, and a rating of "Down" indicates unsatisfactory results. Conversely, post-change metrics indicate whether the leading maintenance performance metrics were satisfactory (or not) at the end of the organizational structures' life cycle.

In order to answer the force downsizing criteria, with the highest possible degree of accuracy, Air Force historical statistics are graphically displayed with an overlay of the timeline of organizational change (Figure 3). An evaluation of slope was applied to each of the organizational change cases to determine whether the personnel end strength was increasing or decreasing at the start of the organizational change.

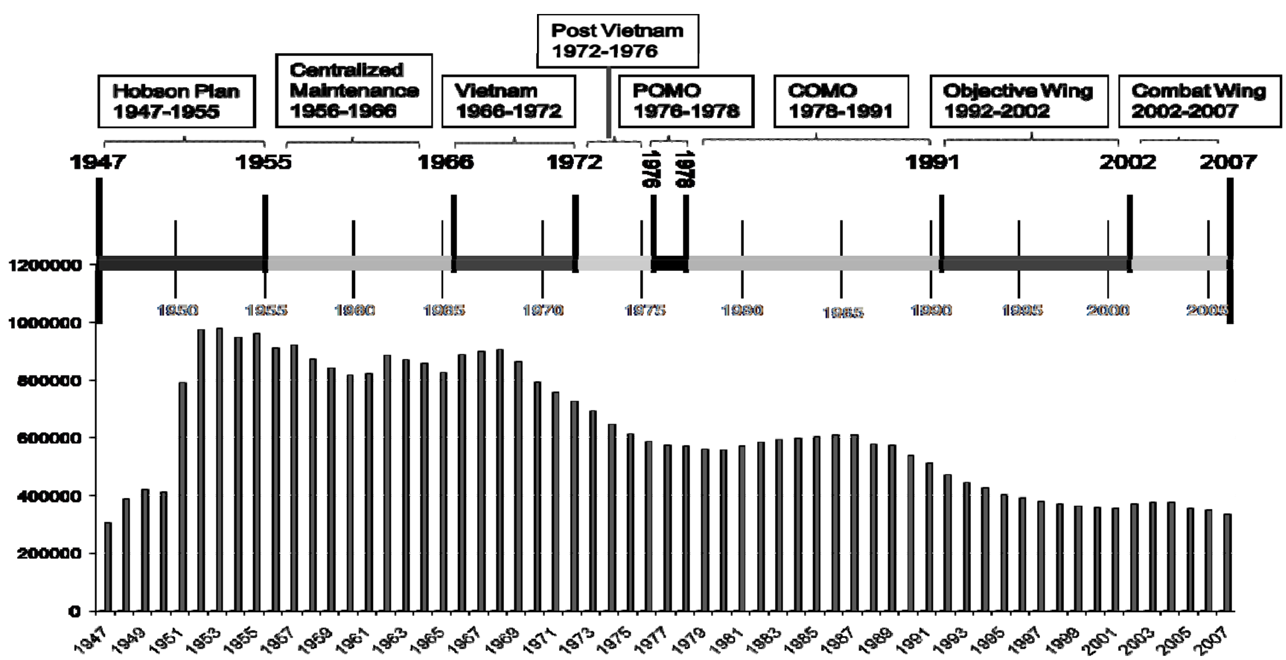

Figure 3. Historical Air Force Personnel End-Strength with Overlay of Organizational Change (OSD, 2007).

Identifying the trend in historical Air Force budget spending was more difficult. An analysis of historical pure dollars spent showed a steady exponential increase over time. This data was of little value when comparing organizational changes over different eras. Thankfully, the Fiscal Year 2008 Greenbook had an attached analysis of historical Air Force spending over time with a calculation for inflation and value of the dollar based on a common economic value, they called this the 2008 dollarization. Figure 4, shows the historical Air Force budget spending with the overlay of organizational changes, and uses the 2008 dollarization.

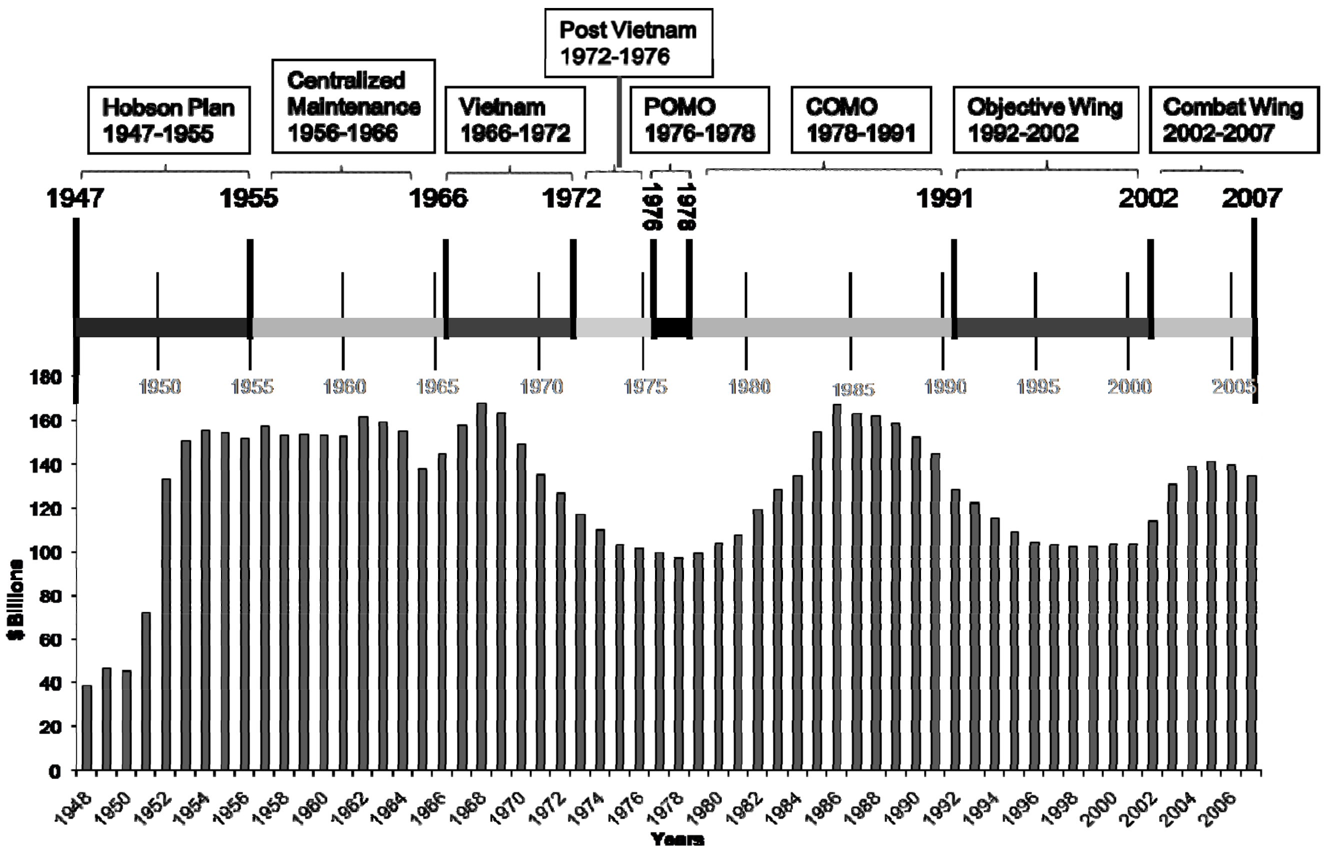

Figure 4. Historical Air Force budget (2008 dollarization) with Overlay of Organizational Change (OSD, 2007).

When analyzing the strategic initiatives of each organizational change case by case a few clear observations can be made. First, the budget and the personnel forces are mostly moving in the downward direction. It appears clear that these trends are unlikely to change in the future. Next, organizational changes happen with great frequency following downturns in either budget or force end-strength.

Critical examination of the strategic initiatives chronicled in Table 1, indicate a strong relationship between force increase, budget increase and major conflict affecting an organizational change from centralized to decentralized structure. Conversely, there is an equally strong relationship between force decrease, budget decrease and the cessation of major conflict leading to organizational change from decentralized to centralized structure.

Further comparison of Table 2, indicates no significant relationship between positive post-change metrics and type of control (centralized or decentralized). The end goal of any initiated organizational change should be to attain satisfactory, or higher, metrics. Of the eight cases studied, only three demonstrated satisfactory post-change metrics. COMO showed the highest post-change metrics, attaining the highest mission capable rates in Air Force history.

Analysis of information and maintenance technology, and change and process management processes provide support for the findings listed above.

COMPARATIVE ANALYSIS OF INFORMATION TECHNOLOGIES

The criteria for the information technology initiatives were more than the strategic initiatives were. Two questions were asked, first was there evident advancement in information technology, as related to aircraft maintenance, and was there an advantage gained from this technology. Table 3 evaluates the information technology initiatives.

Table 3. Information Technology Matrix.

	The Hobson Plan and the Period of Uncertainty (1947-1955)	Centralized Maintenance (1956-1966)	Vietnam and the Move Toward Decentralization (1966-1972)	Post Vietnam Centralization (1972-1976)	Production Oriented Maintenance Organization (1976-1978)	Combat Oriented Maintenance Organization (1978-1991)	Objective Wing Organization (1992-2001)	Combat Wing Organization (2002-2007)
Centralized or Decentralized	Decentralized	Centralized	Decentralized	Centralized	Centralized	Decentralized	Decentralized	Centralized
Information Technology								
Evident Advancement	No	Yes	No	Yes	No	Yes	Yes	Yes
Advantage gained	No	Yes	Yes	Yes	No	Yes	Yes	Yes

Analysis of the information technology aspect of the organizational change cases showed steady development and gains in maintenance data collection and reporting. No strategic advantage was evident during the collection of this data for this study. The aspect of information technology was added to this study due to the impending enterprise resource planning effort underway for ECSS. ECSS will provide efficiencies and decrease informational workloads that will revolutionize maintenance reporting. This portion of the research was an attempt to identify if any similar revolutions had occurred regarding aircraft maintenance.

COMPARATIVE ANALYSIS OF MAINTENANCE TECHNOLOGIES

Aircraft upgrades and add-on systems made keeping up with aircraft technology a very difficult process. The advent of the Air Force as a separate force followed very closely with the technological advances moving away from reciprocating engines towards an all jet force. The three criteria on the left of Table 4 are “Significant Aircraft Upgrade,” this area considers development of more advanced aircraft. “New Maintenance Techniques” considers improvements such as the specialized maintenance concept and cross utilization training. “Other Maintenance Tech Advances” includes things such as the mobile maintenance vans employed during Vietnam, and the fielding of unmanned aero vehicles.

Table 4. Maintenance Technology Matrix.

	The Hobson Plan and the Period of Uncertainty (1947-1955)	Centralized Maintenance (1956-1966)	Vietnam and the Move Toward Decentralization (1966-1972)	Post Vietnam Centralization (1972-1976)	Production Oriented Maintenance Organization (1976-1978)	Combat Oriented Maintenance Organization (1978-1991)	Objective Wing Organization (1992-2001)	Combat Wing Organization (2002-2007)
Centralized or Decentralized	Decentralized	Centralized	Decentralized	Centralized	Centralized	Decentralized	Decentralized	Centralized
Maintenance Technology								
Significant Aircraft Upgrade	Yes	Yes	Yes	No	No	Yes	No	Yes
New Maint Techniques	Yes	No	No	Yes	Yes	Yes	No	No
Other Maint Tech Advance	No	No	Yes	No	No	Yes	Yes	No

Analysis of Table 4 indicates a very loose and sporadic relationship between maintenance technology and organizational change success. It’s clear that developing maintenance technology has changed aircraft maintenance, but, identifying a trend in this data is ambiguous at best.

COMPARATIVE ANALYSIS OF CHANGE AND PROCESS MANAGEMENT PRACTICES

The criteria evaluated in regards to change and process management practices was a determination of whether top Air Force level managers communicated behaviors that were likely to have positive effects on the proposed organizational changes. These behaviors were either evident or not. This research found evidence of senior leader involvement and support in each of the cases, however, behavior that displays a specific, attainable, positive future is likely to influence subordinate behavior in ways that help foster successful organizational change. Likewise, process management practices were either evident or not. Specific instances where Air Force leadership set clear, measurable attainable guidance for the methodical attainment of desired end-states were classified as evident.

Analysis of Table 1 indicated a very strong relationship between successful post-change metrics and leader provided a clear vision. Further analysis of Table 5 indicates that the finding of this strong relationship is strengthened when the clear vision was supported by evident change and process management processes. Additionally, there was a clear relational pattern between the evidence of change and management practices and the centralized organizational structure. Conversely, the decentralized structure rarely displayed the use of change and process management practices while implementing the new organizational structure.

Table 5. Change and Process Management Practices

	The Hobson Plan and the Period of Uncertainty (1947-1955)	Centralized Maintenance (1956-1966)	Vietnam and the Move Toward Decentralization (1966-1972)	Post Vietnam Centralization (1972-1976)	Production Oriented Maintenance Organization (1976-1978)	Combat Oriented Maintenance Organization (1978-1991)	Objective Wing Organization (1992-2001)	Combat Wing Organization (2002-2007)
Centralized or Decentralized	Decentralized	Centralized	Decentralized	Centralized	Centralized	Decentralized	Decentralized	Centralized
CHANGE MANAGEMENT								
Leadership Provided Clear Vision	No	Yes	No	Yes	No	Yes	No	Yes
Change Mgmt Evident	No	Yes	No	Yes	Yes	Yes	No	Yes
Process Mgmt Evident	No	Yes	No	Yes	No	Yes	No	Yes

Summary

This chapter discussed the research results within the framework of the investigative questions. The next chapter examines what conclusions can be drawn from these findings in order to answer the overarching research question, and discusses implications of the conclusions.

V. CONCLUSIONS AND IMPLICATIONS

Chapter Overview

This chapter is organized into three sections. The first section brings together the research findings discussed in the previous chapter and examines how they can be used to answer the overall research question. The second section examines the driving forces behind the cyclicality found between the organizational changes. The third section contains recommendations for future research on this topic.

Answering the Research Question

"Which factors lead to large scale organizational changes in the Air Force?"

As discussed in chapter 1, this research sought to identify the key factors that affect organizational change in the Air Force in order to help planners maximize the probability for success of future changes. The findings in chapter 4 highlighted the main recurring factors that have affected the Air Forces' organizational changes.

Strategic Initiatives

Critical examination of the strategic initiatives, identified a strong relationship between force increase, budget increase and major conflict affecting an organizational change from centralized to decentralized structure. Conversely, there is an equally strong relationship between force decrease, budget decrease and the cessation of major conflict leading to organizational change from decentralized to centralized structure. Additionally, this research has identified a strong relationship between leadership providing a clear vision and positive post-change metrics. This relationship holds in every incidence of a clear leadership vision except the post Vietnam period. Mitigating factors for this anomaly could be attributed to the drastic decline in personnel at the end of the Vietnam conflict, or the strong decline in budget.

Information Technology Improvements

Analysis of the information technology aspect of the organizational change cases showed steady development and gains in maintenance data collection and reporting. This research revealed no relationship between these advances and organizational change tendency.

Maintenance Technology Improvements

Analysis indicates a very loose and sporadic relationship between maintenance technology and organizational change. It's clear that developing maintenance technology has changed aircraft maintenance, but, identifying a trend in this data is ambiguous at best.

Change and Process Management Practices

Analysis indicated no relationship between change and process management processes and pressure to change organizational structure; however, there was a very strong relationship between successful post-change metrics and when the leader provided a clear vision. Further analysis indicates that the finding of this strong relationship is strengthened when the clear vision was supported by evident change and process management processes.

Summary

This research has determined that the key factors that have led to organizational change in the Air Force are (1) force increase or decrease, (2) budget increase or decrease, and (3) the presence or cessation of major conflict. During every period of change, force increase, budget increase and major conflict or force decrease, budget decrease and cessation of major conflict have had a strong relational affect leading to organizational change. Additionally, this research has found that when clear leadership vision is present, it has a strong relational affect on the post change metrics associated with the given organizational change.

Cyclicality

The business double helix shows the evolutionary tendencies of corporations competing in the open-market; the maintenance double helix (Figure 5) adapts the evolutionary model to fit Air Force organizational changes. There are several differences between the business and maintenance models, including the lack of external competitors, proprietary standards and market power indicators. However, several key similarities make this evolutionary model useful in explaining the forces motivating the Air Force's maintenance organizational changes. Industry's vertical organization is very similar to the Air Force's centralized concept and a horizontal business model is controlled in a similar way to the Air Force's decentralized organization. Additionally, both models have specific, identifiable forces moving each structure towards a cyclical change.

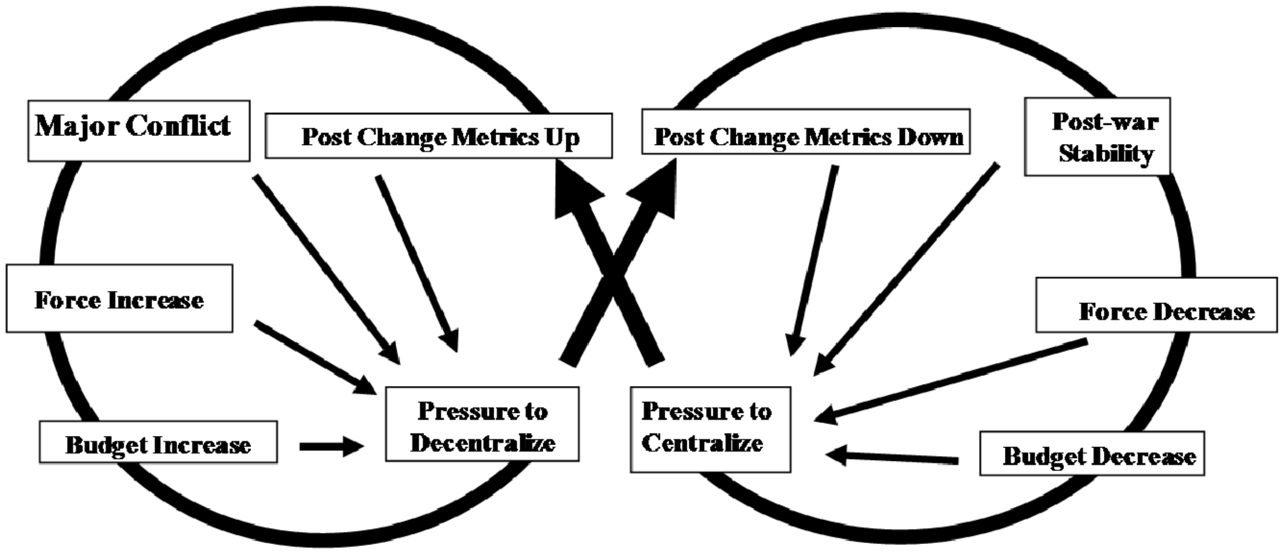

Figure 5. The Maintenance Double Helix.

This research has shown a clear cyclical pattern between centralized and decentralized maintenance. Figure 6 shows the pattern of changes from decentralization to centralization and so forth. The analysis of strategic initiatives, information and maintenance technological advances has revealed that several factors drive the transition from centralized to decentralized organization.

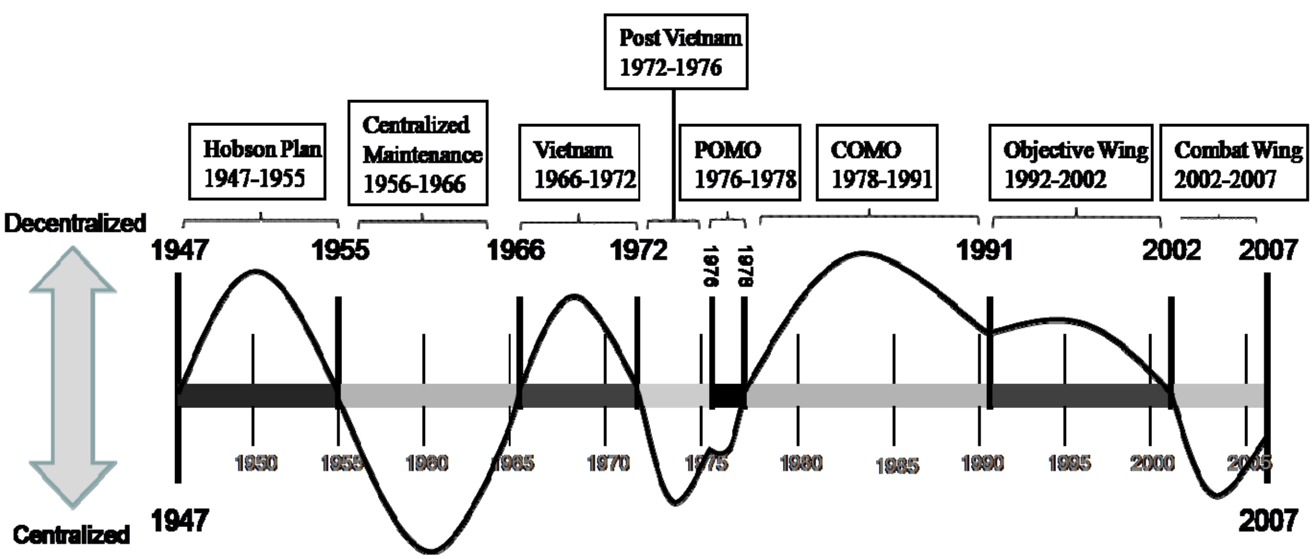

Figure 6. Centralized-Decentralized Cyclicality Timeline

Centralized to Decentralized Organization

During times of post-war stability the Air Force has primarily used a centralized organization. Whenever a centralized structure was evident, the forces of major conflict, force increase, budget increase, and improved post-change metrics were moving the organization towards a shift to decentralization. Analysis of maintenance and information technology advancement has shown no significant pattern moving towards decentralization.

The centralized maintenance organization era of 1956-1966 showed exactly the same indicators as the post-Vietnam period (1972-1976) in strategic initiatives and information technology, with one exception (post-change metrics). Both periods showed force draw-downs and budget cuts related to post-war stability. The difference in post-change metrics is likely due to the severity of cuts following Vietnam, especially to the core of maintenances' experience base.

The POMO period was a partial move along the centralized maintenance organizational spectrum. This change was the first instance of a change that didn't swing all the way back to decentralized from centralized. However, POMO was a significant shift towards decentralization from the pure-centralized organization used in the post-Vietnam period.

Decentralized to Centralized Organization

Decentralized maintenance seemed to be the Air Force's preferred war fighting organization. During periods of decentralized maintenance, and after each major conflict, the forces of post-war stability, force decrease, budget decrease, and declining post-change metrics moved the organization back towards centralization. Analysis of aircraft upgrade and technological advancement has shown that in three of four cases it also leads towards centralization. This factor could be closely correlated between the timing of the major aircraft upgrades and the major conflicts.

The Hobson Plan era of decentralization was marked by early uncertainty and later by the Korean War. As the uncertainty cleared up and the Korean War ended, this era showed the same traits as the Vietnam era and COMO. In each case after the conflicts were over (Vietnam, Cold War and DESERT STORM), the force decreased, the budget decreased, and shortly thereafter the structure changed back towards centralization.

Similar to POMO, when the Air Force changed from COMO, it didn’t swing completely to the centralized concept. The Objective Wing was a move towards centralization, but, it wasn’t a complete reversion.

Summary

The strongest relationship among drivers seemed to be the increase or decrease in personnel and budget. Each case of budget and force reduction moved the organization towards centralization. Conversely, during periods of increased budget and personnel the organization moved towards decentralization. The personnel and budget trends are certainly tied closely to the occurrence of major conflict. In three of four cases, major conflict was a key driver in the shift towards the decentralized concept.

Implications to Future Organizational Changes

All current indicators point toward a smaller Air Force. History has shown that when the force gets smaller, our maintenance organization moves towards centralization. It appears certain that the budget trend is likely to continue to decline; this factor has also held historical significance towards the centralized concept. Military operations in Iraq and Afghanistan have continued over the last several years, however; it seems likely that these conflicts are becoming more stable over time. Increased stability, also suggests movement towards a centralized maintenance concept.

An assessment of the strategic initiatives affecting the Air Force today makes it seem likely that the maintenance organization would remain centralized. Force down-sizing, budget reductions and the decrease of military operations, in-support of the Global War on Terrorism, are the most evident environmental pressures toward centralization.

The advent of the Global Logistics Support Center (GLSC), as the Air Force's office of primary responsibility for supply chain management decision-making, and ECSS's emerging solution, for the Air Force's logistics information needs, have enabled the Air Force to streamline its logistics command and control. This shift in logistics control has allowed the Air Force to select a decentralized structure for its latest reorganization. Air Force Chief of Staff, General T. Michael Moseley has published a plan to reorganize wing-level maintenance along a decentralized structure. In a return to the model used under the Objective Wing, the AMU will be aligned under the operations commander, imbedded within the tactical flying squadron.

According to the findings of this research, all environmental factors indicate pressures toward the centralized maintenance organization. The pressures that have historically led to a decentralized maintenance structure are not present at this time. However, the efficiencies provided by the GLSC and ECSS may prove to be the antecedents for a successful transition to the decentralized organization.

Recommendations for Future Research

A study commissioned by the Air Force Chief of Staff regarding the optimal maintenance organizational structure, based on evaluation of the Objective and Combat Wing concepts may be of significant value. General Creech found great success when he commissioned a similar study prior to the implementation of COMO.

This research has found that a clear leadership vision is a key factor in successful organizational change; a comprehensive research effort into how leaders provide this clear, attainable vision may be very valuable. Knowledge of which factors positively affect change is very important, the next step is to learn how best to influence these factors, in order to maximize the benefits of doing the right things.

Additionally, an in-depth study of Air Force maintenance related information technology could be helpful in identifying a more definitive relational influence on organizational change. An in-depth study focused specifically on Air Force change management practices could also be helpful in identifying the most influential factors in implementing large scale organizational changes or programs.

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Vita

Captain Jeffrey M. Durand graduated from Blackstone-Millville Junior and Senior High School in Blackstone, Massachusetts. He enlisted in the Air Force in 1991, where he worked as an Aircraft Guidance and Control Systems technician for ten years. He entered undergraduate studies at the extended campus of Embry-Riddle Aeronautical University at MacDill AFB, Florida where he graduated with a Bachelor of Science degree in Professional Aeronautics in May 1998. He was commissioned through Officer Training School at Maxwell AFB, Alabama, in June 2001.

His first officer assignment was at the 319th Air Refueling Wing, Grand Forks AFB, North Dakota as a Logistics Planner in July 2001. In May 2003, he was assigned to the 354th Logistics Readiness Squadron, 354th Fighter Wing, at Eielson AFB, Alaska. He performed the duties of Traffic Management, Material Management, and Fuels Management Flight Commander, within the Logistics Readiness Squadron. He deployed for five months to US Central Command Headquarters in support of Operation Iraqi Freedom. He was assigned to the Joint Logistics Mobility division where he was responsible for coordinating airlift requirements between US Transportation Command and the Persian Gulf Area of Responsibility.

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14. ABSTRACT
Air Force leadership has ordered the development of an Enterprise Resource Planning (ERP) system called the Expeditionary Combat Support System (ECSS). Many current jobs and positions will be streamlined, restructured or removed, while some will certainly be created to handle the new requirements associated with ECSS. The structure of the Air Force is certain to change with the implementation of ECSS. The Air Force has used many maintenance organizational structures since its inception in 1947. The focus of this research is to analyze past organizational structures to define key factors that affect organizational change. A case study style methodology was applied to eight periods of maintenance-related organizational change. Strategic initiatives, information and maintenance-related technology advances, change and project management practices were evaluated for relational affect. The researcher found that the strongest relational variables leading to organizational structure change were force-size change, budget change and major conflict occurrence or cessation.

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