ISSUES RELATED TO ALTERNATIVES TO CURRENT PROCEDURES IN THE UNSCHEDULED MAINTENANCE OF AIR FORCE AIRCRAFT

GRADUATE RESEARCH PROJECT

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Acknowledgements

During my research I read one thesis that particularly struck me. The author's acknowledgement page started with the most important people first. What a brilliant idea! Normally, during our various occasions to mention them in our career, they are reserved for last, almost a footnote, and they certainly are not. I am deeply appreciative of the enduring trust and patience my wife has given me while I lead our way through this Air Force life. This year has been very trying while I seemed to be home more often than in years past but was hardly ever really there. We prepare now to take the circus tents down and press on to the next town. I am grateful her patience continues.

Of course I am gratefully indebted to the leadership and guidance of my sponsor, Colonel John Easley, and my academic advisor, Major Stephen Swartz for their critical review of this work. Col Kent Mueller also continues to challenge my preconceived notions (and everyone else's). Maj Paul LaVigne deserves some recognition here as well. He doesn't think like the typical Air Force officer and facilitated new and innovative thought. If there are any failings in this paper they are rightfully placed squarely on my shoulders and should not reflect poorly on these great warriors.

Finally, and certainly not least, I owe a debt of gratitude to Lieutenant Colonel Paul Webb who asked me to apply to this outstanding program. And to my fellow quiet professionals of the 352d Special Operations Group (HOOAH) who provided invaluable assistance in the preparation of this paper. Particularly Lieutenant Paul Kostansek and Master Sergeant Edward Aring who do the incredible task of keeping the SOG in parts.

Blue Skies,

Daniel M. Wuchenich

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Abstract

The purpose of this paper is to identify issues related to alternative procedures in the unscheduled maintenance of Air Force aircraft. Specifically, the procedures investigated are those used by the 352d Special Operations Group (SOG) in sourcing expendable aircraft parts for which estimated delivery dates are unacceptable. The SOG's experience has been that direct sourcing from private contractors has resulted in superior delivery response times. Further, they believe that their experience with expendables could be extended into the management of reparables. Since adopting these procedures formally would require changes in Air Force policies, these procedures need to be evaluated from a broader level. The intent of this paper is to identify the issues related to such an analysis. Because the subject of this research topic has not yet been thoroughly or formally investigated, the sources of information were primarily expert opinions, combined with an analysis of related theses, reports, and journal articles. The major finding of this research has been that while the relationship between spares levels and readiness is fairly direct, the relationship between cost and readiness is not. A third dimension of the problem is proposed. Further research into the issues surrounding the cost-readiness tradeoff is recommended.

ISSUES RELATED TO ALTERNATIVES TO CURRENT PROCEDURES IN THE UNSCHEDULED MAINTENANCE OF AIR FORCE AIRCRAFT

I. Background and Statement of the Problem

Overview

Stating that they are unable to execute their mission with some of the estimated delivery dates (EDDs) provided for expendable repair parts supplied by the depot, the 352d Special Operations Group (SOG) has established procedures that allow using local contractors to provide these parts faster. According to reports from the 352d Maintenance Squadron (352 MXS), these parts are frequently obtained at less cost and faster than if they came from the depot, and are from the same original equipment manufacturer (OEM). The unit believes that these local contractors possess the capability to actually repair some of the reparable parts as well. Because this will require changing Air Force policies, this issue needs to be evaluated from a broader level to identify the actual total costs and benefits of such a proposition. The intent of this paper is to identify the issues that should comprise a cost-benefit analysis of the process of locally purchasing repair parts (consumables and reparables) from non-depot sources.

Problem

The decision to use local contractors to supply depot level expendables has been made from the unit level perspective, and, while initially appealing, may not provide as many benefits as is currently assumed. A broader analysis of the depot vs. private contractor problem will identify key issues surrounding these processes. By identifying

what the issues are, logistics officers will be better equipped to make rational cost benefit analysis decisions. This research seeks to assist those logistics officers by identifying the key issues involved.

Background

The 352 SOG uses unique procedures for obtaining expendable repair parts in the performance of unscheduled maintenance. When the part needed to repair the aircraft is not available from base supply and the EDD from depot is unsatisfactory, the SOG looks to local depot-level contractors to see if they can supply the part. If they can get the part to the SOG sooner than the depot, the SOG seeks item manager (IM) approval to install the contractor's part. It has been reported that the SOG has frequently been able to get the parts sooner and cheaper from the contractor than if they went to depot. If this can be demonstrated, and if these contractors have demonstrated depot-repair capability, then the possibility to use these contractors in the repair of depot-level expendables may exist. This paper explores the issues involved with this decision. First, it is necessary to examine the need that has been established in the logistics community to make some significant changes.

In his October 1999 testimony before the House Armed Services Committee, General George Babbitt, Commander, Air Force Materiel Command stated:

> The readiness of Air Force Weapons systems has been jeopardized for several years by the lack of spare parts and repair parts. Since 1991, the Air Force has experienced a steady decline in aircraft mission capable (MC) status from an average of 83 percent to an average today of 73 percent. (Simard, 2000).

General Babbitt has not been alone in his criticism. Other assessments of Air Force logistics and aircraft maintenance in particular are included later in this paper.

Many studies have recognized this downward trend and lack of timely availability of repair parts. This paper will explore issues related to alternative procedures in the unscheduled maintenance of Air Force aircraft as one method to improve this downward trend.

Definitions

The provision of spare parts is a complex system with its own unique technical terminology. Air Force Instruction 21-101, Maintenance Management of Aircraft, provides these definitions fundamental to the development of this paper (AFI 21-101, 1998):

On-Equipment Maintenance – Maintenance tasks that are or can be effectively performed on or at the weapon system or end-item of equipment. [On the airplane]

Off-Equipment Maintenance – Maintenance tasks that are not or cannot be effectively performed on or at the weapon system or end-item of equipment.

Depot Level Maintenance – Maintenance consisting of those on- and off-equipment tasks performed using the highly specialized skills, sophisticated shop equipment, or special facilities of a supporting command; commercial activity; or inter service agency at a technology repair center, centralized repair facility, or, in some cases, at an operating location. Maintenance performed at a depot may also include organizational or intermediate level maintenance as negotiated between operating and supporting commands.

Intermediate-Level Maintenance – Maintenance consisting of those off equipment tasks normally performed using the resources of the operating command at an operating location or at a Centralized Intermediate Repair Facility [CIRF].

Organizational Level Maintenance – Maintenance consisting of those on-equipment tasks normally performed using the resources of an operating command at an operating location.

Two Level Maintenance (2LM) – Avionics and engine maintenance previously done by the intermediate level is now done either on the flightline or in depot repair shops. Under 2LM depot repair becomes tied directly to the Air Force flightline and unit sortie generation capabilities.

Lean Logistics - An outgrowth of the 2LM program focusing on rapid depot repair and high velocity two-way movement of parts. It includes the use of best business practices including the maximum use of express carriers, expedited processing of reparables by bases to the depot, flexible and responsive repair processes that sustain quality repair, quick response contracts (both depot repair and bit and piece support), and more direct user involvement in spares distribution decisions to achieve optimum support.

Although not included as a definition in AFI 21-101, the following definition was obtained from Joint Publication 1-02, Department of Defense Dictionary of Military and Associated Terms:

Cannibalize — To remove serviceable parts from one item of equipment in order to install them on another item of equipment.

Two more concepts are defined by FAA Order 8300.10, the Airworthiness Inspector's Handbook (Federal Aviation Administration, 1996):

Scheduled Maintenance: A group of tasks, accomplished at specified intervals, that prevents deterioration of the safety and reliability levels of the aircraft.

Unscheduled Maintenance: A group of tasks resulting from scheduled maintenance, reports of malfunctions, and data analysis used to restore equipment to acceptable safety and reliability levels.

Some additional concepts and organizations in the repair system will also need to be discussed at this time. The following parts of the Defense Working Capital Funds (DWCF) concept must be described (AFI 65-601V1, 2000):

DBOF: Defense Business Operations Fund. Defense Management Report Decision (DMRD) 971, DOD Financial Systems, established the DBOF and provided the foundation for operational policies and procedures. Through the creation of DBOF, DOD expanded the use of businesslike financial management practices.

DWCF: The Defense Working Capital Funds were established in 1996 and built on the DBOF foundation. The financial principles of DWCF improves cost visibility and accountability to enhance business management and improve the decision making process. The DWCF uses revolving fund principles previously used for industrial and commercial-type activities. Successful implementation of the DWCF is considered essential to achieving the following DMR initiatives:

1. Consolidating like functions,
2. Increasing cost visibility, and
3. Realizing significant monetary savings through better business practices.

Under the DWCF structure, customers establish requirements and are charged, through the rate structure, for the cost of industrial and commercial-type services and products provided. Providers, in turn, produce quality goods and services that satisfy customer requirements at the lowest cost. By making the producing organization responsible for all costs associated with delivering the good or service, those managers will identify cost drivers and can focus their management improvement efforts accordingly.

The DWCF eliminates direct appropriations for many elements of cost in existing funds. Sales to customers must reflect total costs not just direct costs. Replacement of DBOF with DWCF returned cash management responsibilities to the Components. Although the Military Departments retain control of their respective business areas, the Service's focus is supposed to be on cost management.

Activity Groups: An aggregation of DWCF activities, within a Component, that produces similar products and is under the management control of the same higher level organization and/or individual. Air Force Activity Groups include: [this list is abbreviated for inclusion in this paper] Depot Maintenance Activity Group (DMAG), and the Supply Management Activity Group (SMAG).

DMAG: The DMAG provides repair and other services to customers throughout the Air Force, as well as to other DoD components, U.S. government agencies, and foreign governments. The DMAG repairs a wide range of customer assets, including aircraft, missiles, aircraft engines, and engine modules, landing gears, electronics, composites, and computer hardware and software. In addition, the DMAG centers are the primary suppliers of repair services to the Supply Management Activity Group (SMAG).

SMAG: The SMAG provides policy, guidance, and resources to meet the needs of the Air Force for spare parts, in war and peace. There are five divisions in the SMAG: The Material Support Division (MSD), General Support Division (GSD), Fuels Division, Medical/Dental Division, and Academy Cadet Store Division. The Troop Support Division ended supply services in FY 1999. Within these divisions, the SMAG manages weapons systems spare parts, fuels, medical/dental supplies and equipment, and items used for non-weapon system applications. Material is procured from vendors and held in inventory for sale to authorized customers.

While the previous descriptions emphasize how the DMAG supplies repair services to the SMAG, it fails to emphasize how the SMAG is responsible for providing the parts to be repaired in the first place. It has been reported that operational units have had to send their reparable to depot to be repaired and returned, instead of being

submitted for an exchange because there are not enough spares in the system to absorb these fluctuations. One final citation from AFI 65-601V1 clarifies the roles and responsibilities of the Materiel Support Division:

> The Supply Management Activity Group (formerly stock fund) repairs and buys materiel items from commercial or other government sources. The Materiel Support Division (MSD) primarily finances the repair and purchase of reparable items. Also, consumable items that did not transfer to the Defense Logistics Agency are managed under MSD. Supply Management customers will pay the DWCF when they place orders. Customers will place orders only for supplies or equipment needed in the current fiscal year, or for supplies and equipment whose lead time requires obligation of current year funds to ensure they are available when needed. (AFI 65-601V1, 2000)

Description of Future Chapters

This chapter sought to give a broad overview of a supply problem faced by the Special Operations Group and the Air Force, and to lay the background for understanding the remaining text by including appropriate definitions. Future chapters will narrow the focus considerably.

Chapter II is a literature review of journal articles, AFIT and PME theses, and other publications. These sources are used to describe the need to make changes in the logistics system for the SOG in particular and the Air Force in general, describe changing policies with regards to the extent of public depot repair, and explain the typical unscheduled maintenance and repair cycle processes. Chapter III provides a description of the methodology. This will be accomplished with an analysis of historical archives and personal interviews for the specific case involving the 352 SOG. Chapter IV presents the results of the analysis. Key issues are identified and discussed, with their

managerial implications. Chapter V summarizes the paper with conclusions and recommendations for future research.

II. Literature Review

The battle is fought and decided by the quartermaster
before the shooting begins.
– Field Marshall Erwin Rommel

Overview

The purposes of this literature review are to provide the background illustrating the imperative for the SOG's (in particular) and the Air Force's (in general) logistics systems to make improvements, describe the changing policies with regards to the extent of public depot repair, describe the unscheduled maintenance process, and outline the typical repair cycle process.

Imperative to Improve

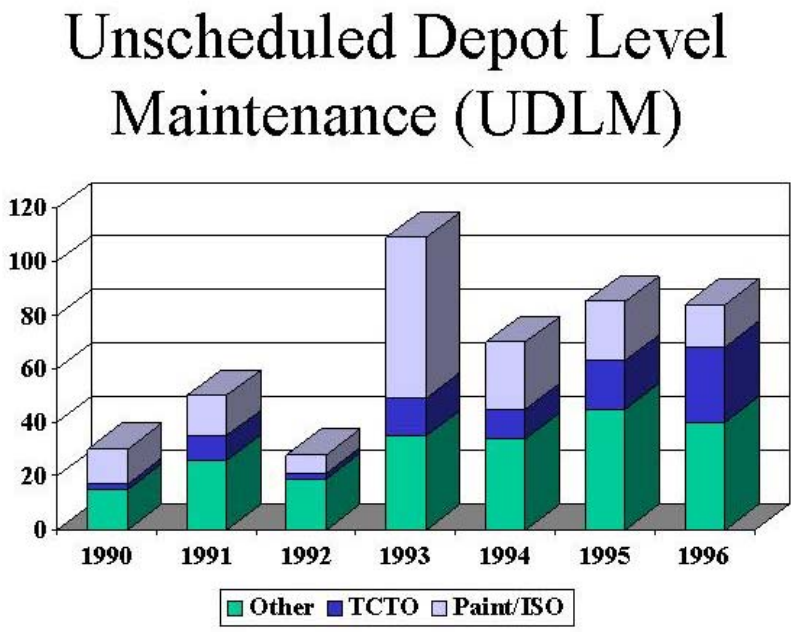
The purpose of this next section is to describe the need for improvement in the SOG's and the Air Force's logistics systems. This literature review will reveal that unscheduled depot maintenance is increasing, that depot costs increase significantly with age, and increase faster with complex weapons systems. This combination of aging, complex weapons systems is causing logistics trouble for the 352 SOG and the Air Force.

Numerous sources have highlighted the need for change in the Air Force logistics community. Whether one considers mission capable rates Air Force wide, depot cycle times, or parts supply rates the numbers seemed to have suffered since the end of the Cold War. The Air Force's Logistics Transformation Office (AF/ILMT) has recently outlined 30 pilot programs that will test new initiatives at 18 bases this coming year (Bosker, 2001). But the opportunity for change hasn't been limited to higher headquarters initiatives. Operational units like the 352 SOG have often, within the

bounds of regulation and law, tried new procedures to improve readiness. The SOG has been motivated in part by facts like those presented below.

The amount of unscheduled depot level maintenance is increasing in the C-130 community. This is apparent in the figure below (Annis, 1996):

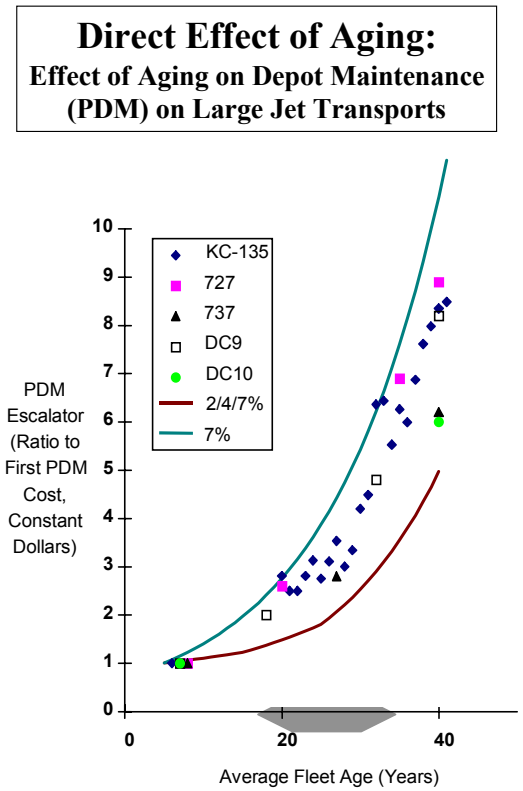
Fig 1. Unscheduled Depot Level Maintenance for C-130s



Included as Appendix A in Annis' work, the figure above represents the total number of unscheduled depot level maintenance tasks that depot field teams (DFT's) and contract field teams (CFT's) were tasked to repair for the period 1990-1996. The depot level maintenance tasks are subdivided into time changes (components that are required to be removed and replaced at specific intervals), paint/isochronal inspection, and other (which included battle damage, corrosion, cracking, mishap, & system malfunction). There appears to be a distinct upward trend in the amount of unscheduled depot work

over time. Because the SOG operates 11 C-130's they are affected by this trend. Whether the causes are related to the age of the aircraft or can be attributed to some other factor(s) is not known at this time. However, there is evidence that suggests that as weapon systems age, the amount and cost of depot level repairs increases (Spinney, 1998). While the SOG's Combat Talon II's are young by C-130 standards (manufactured between 1984 and 1988), their Combat Shadows are among the 'old' C-130s (manufactured in 1969). In fact, the SOG also has one 'slick' C-130E that dates from 1963. The following figure highlights the effect of aircraft age on depot costs (Spinney, 1998):

Fig 2. Depot Costs Increase with Age



Cost Drivers:

- Stress degradation
  - ✓ Fatigue, thermal cycles
- Corrosion & material degradation
  - ✓ Airframes, subsystems, avionics & propulsion
- Parts Obsolescence
  - ✓ "Bit & Pieces," major components, avionics systems
- Capability Mods to Upgrade Older A/C

Readiness Degraders:

- More frequent failures
  - ✓ Longer repair times
  - ✓ Increased Cann Rates
  - ✓ Higher workloads
  - ✓ = Lower Mission Capable Rates
- Shrinking Forces
  - ✓ Retirements w/o replacement to cut support costs

Although the figure above comes from Spinney's 1998 PowerPoint brief, "Defense Death Spiral", the same data appears to be used later by the Rand Corporation

in preparing Raymond Pyles' statement before the Procurement Subcommittee of the House Armed Services Committee in February 1999. Figure 2 shows the cost of programmed depot maintenance (PDM) as a factor of the cost for the first PDM accomplished. If the 'PDM Escalator' (the y-axis) is 4 it means that the cost of that PDM was four times the cost of the first one accomplished. The x-axis represents the average age of the fleet. What Spinney and Pyles found was that, in general, "if previous cost-growth trends were to continue, annual PDM and engine-support costs would increase $5-6 billion by 2020" (Pyles, 1999). This statement was based upon a review of historical and planned heavy-maintenance workloads for the KC-135, 727, 737, DC-9, and DC-10. In every circumstance, the heavy-maintenance workload increased from five- to nine-fold over a 40-year span. The SOG flies what have been described as the most complex helicopters, and what are certainly some of the most complex C-130s in the Air Force. These aircraft are briefly described next.

MC-130P, Combat Shadow. Flies clandestine, or low visibility, low-level missions into politically sensitive or hostile territory to provide air refueling for special operations helicopters. Secondary missions include the airdrop of small special operations teams, small bundles, and zodiac and combat rubber raiding craft; as well as night-vision goggle takeoffs and landings, and tactical airborne radar approaches. These aircraft have fully integrated inertial navigation and global positioning system (GPS) and night-vision goggle-compatible interior and exterior lighting. They also have a forward-looking infrared radar, missile and radar warning receivers, chaff and flare dispenser, night-vision goggle heads-up displays, satellite and data burst communications, and in-flight refueling as a receiver (The Aviation Zone, 1997).

MC-130H, Combat Talon II. Provides global day, night, and adverse weather capability to infiltrate, resupply, and exfiltrate U.S. and allied special operations forces. In order to accomplish this mission, these aircraft are equipped with in-flight refueling equipment (receiver only), terrain-following and terrain-avoidance radar, an inertial and global positioning satellite navigation system, and a high-speed aerial delivery system. The special navigation and aerial delivery systems are used to locate small drop zones and deliver people or equipment with greater accuracy and higher speeds than possible with a standard C-130. The aircraft can also penetrate hostile airspace at low altitudes, and crews are specially trained in night and adverse weather operations. These aircraft have highly automated controls and displays to reduce crew size and workload. The cockpit and cargo areas are compatible with night vision goggles. The integrated control and display subsystem combines basic aircraft flight, tactical and mission sensor data into a comprehensive set of display formats that assist each operator in performing tasks efficiently. Additionally, these aircraft are equipped with an electronic warfare operator's station with displays for viewing electronic warfare data and to supplement the navigator's in certain critical phases (Department of the Air Force, 1999).

These are highly complex aircraft (particularly for C-130's). It has been recognized that increasing aircraft complexity is also related to increasing costs of depot repairs (Spinney, 1998). This is graphically depicted in Figure 3, Depot Costs Increase with Increased Aircraft Complexity:

Fig 3. Depot Costs Increase with Increased Aircraft Complexity

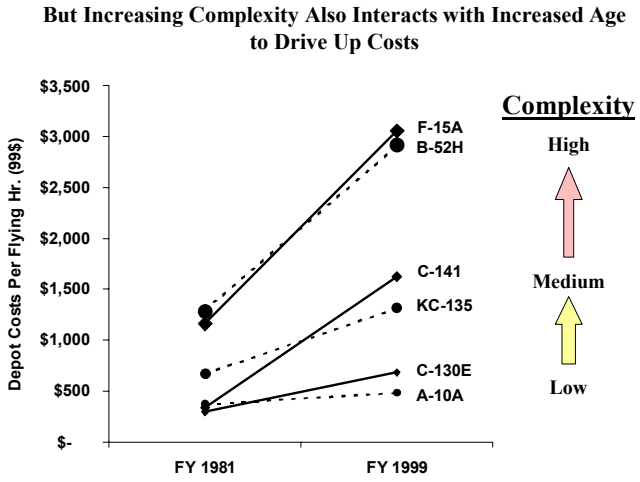


Figure 3 shows that the depot cost per flying hour for highly complex weapons systems (F-16A and B-52H) accelerates faster with age than the 'medium' complexity C-141 and KC-135. It also shows that these medium aircraft accelerate in depot cost per flying hour faster than the 'low' complexity C-130E and A-10A. The implication for the SOG is that their highly complex, aging aircraft puts them in the worst category as far as depot cost growth goes.

This data suggests that the amount and the cost of depot repairs will continue to increase, particularly for older and more complex aircraft. This research will identify issues that will be used to measure alternatives to current procedures in the unscheduled maintenance of these aircraft. These issues will be explored later, but first, let's examine some additional problems with regard to the depots.

Conflicting Guidance and Policies

The purpose of this next section is to describe what factors and groups created the situation in the 1990's that saw government depots required to receive 60% of all of

DOD's depot work. This section describes how this action was followed by calls for complete commercialization of DOD depot work. Then, efforts to repeal the 60% requirement and the establishment of the current policy of 50% is described. It concludes with the Air Force's failure to meet this 50% requirement in FY00, reopening the depot debate in Washington.

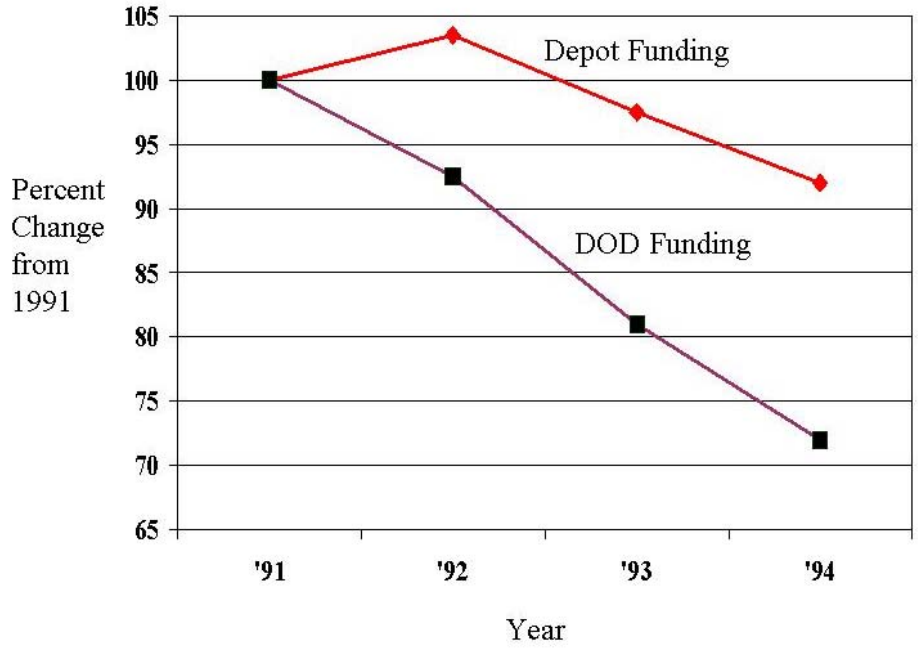
Conflicting guidance and policies concerning depot maintenance workload have been apparent for several years. The problem appears to have begun, not with the more recent 35-percent overall drop in real defense spending, but the 70-percent decline in procurement spending since the mid-1980s (Spaulding, 1997). The large defense contractors sought relief from the lack of new acquisition programs. One strategy they employed was consolidation: "some 40 different companies have consolidated into 5: Lockheed Martin, Boeing, Pratt & Whitney, General Electric, and Raytheon" (Bowling, 2000).

The other strategy was to increase workload by aggressively seeking some of the sustainment functions (and dollars) that the public depots had been providing (and receiving). This was a largely ignored opportunity for many years because there were sufficient acquisition programs to keep the defense industries fully engaged. But as the acquisition programs came to a halt, aerospace companies realized that for every dollar the Department of Defense (DOD) spends on purchasing a weapon system, it will spend at least two more to sustain it over its lifetime (Gruber, 1999). The private sector strategy of going after depot-performed workload resulted in a competition between the public and private sources of repair.

Congressional support effectively fell into two categories, those with government depots in their district (the depot caucus), and those Congressmen successfully lobbied by organizations like the National Defense Industrial Association Industry (NDIA) (Spaulding, 1997). NDIA's self-proclaimed mission is to ensure the continued existence of a strong national technology and industrial base. They hope to achieve this goal through legislative advocacy, education, and public dialogue (NDIA, 2001).

In his paper presented to the Commission on the Roles and Missions of the Armed Forces (CORM) Lieutenant Kirk Rieckhoff stated that during the cold war 65 percent of the depot's work was performed by the public depots. With the post cold war draw down, public depots decreased in number and size from 35 major (400 or more employees) depots and 156,000 people in 1987 to 24 facilities employing 96,000 people in 1995.

Fig 4. Disparity Between DOD and Depot Budget



However, as Figure 4, Disparity Between DOD and Depot Budget shows, while the DOD budget has been cut by 29% since 1991, public depots have been cut by less than 10%. Figure 4 shows the widening gap between DOD and depot budgets as a percentage of their 1991 authorization (Rieckhoff, 1995).

According to Rieckhoff, the DOD expected savings that failed to materialize, and without that money the DOD had to siphon the money out of other areas. He states that "The depot budget has not been cut, because the DOD has maintained 50% more depot capacity than it needs" (Rieckhoff, 1995). He points out that the power of the purse lies with Congress and that the DOD is unable to simply close or reduce the number of employees at its depots. This is where Congress enters the picture. Congress controls the amount of money appropriated to the different sections of the DOD budget. The DOD may not just close a depot if it is no longer needed or easily reduce the number of employees. Because members of Congress staunchly defend the jobs of their constituents, Congress created the Base Realignment and Closure Commission (BRAC) to circumvent the political impossibility of base closings (Rieckhoff, 1995).

Rieckhoff explained that it was because of members of Congress with depots in their districts who did not want the BRAC to close their depots that Congress enacted the "60/40" rule. This law requires the four services to perform 60% of their depot work in public sector depots. No more than 40% may be done by the private sector.
He states that (Rieckhoff, 1995):

> When the law was instituted, the Army had 50% of its depot work done by private companies. The law required the Army to reduce the level of private depot work to 40% over two years. The overall affect has made the public sector depots appear more useful and necessary. Therefore, the BRAC did not close as many public depots as they would have, since a higher number of depots were necessary to meet the 60/40 rule.

Dissatisfied with the depots remaining open, various DoD advisory groups sought other means to further reduce infrastructure costs. According to the 1998 GAO report, two notable groups, the CORM and the Defense Science Board (DSB), separately recommended that the DOD move away from it's reliance on public depots (GAO, 1998). Among other suggestions, the groups recommended outsourcing all depot work on new weapon systems. Specifically, the GAO states that the DSB recommended that the DOD get out of the "materiel management, distribution, and repair business by expanding contractor logistics support to all fielded weapon systems" (GAO, 1998).

CORM and DSB studies estimated that depot maintenance costs could be reduced by 20 to 40 percent through increased outsourcing in a competitive environment, although the GAO found these results to be overstated. In March 1996, the DOD issued DOD 5000.2-R, "Mandatory Procedures for Major Defense Acquisition Programs and Major Automated Information System Acquisition Programs". This new regulation stated that new systems and major upgrade programs "shall maximize the use of contractor provided, long-term, total life-cycle logistics support that combines depot-level maintenance along with wholesale and selected retail materiel management functions." It also stated that program officials must obtain a waiver if they wanted to use public support facilities. DOD revised this regulation in October 1997 to remove the waiver requirement (GAO, 1998).

According to Maj Braman, in his 1997 work, "Privatization of Military Repair Depots", the DOD issued its "Policy Report Regarding Performance of Depot-Level Maintenance and Repair" in response to the National Defense Authorization Act for Fiscal Year 1996. Braman says that it set forth DOD's plans to support new and

upgraded weapon systems within the private sector and that this report also endorsed the repeal of 10 U.S.C. 2466, the so-called 60/40 rule. Furthermore, Braman says that the report also changed the definition of core depot maintenance from those items that must be maintained by the government to meet readiness and sustainability requirements to a limited organic capability to meet essential wartime surge demands, promote competition, and sustain technological expertise (Braman, 1997). Congress did not respond favorably to the report. They criticized DOD's definition of core depot workload, they took exception to the DOD policies that prevented depots from competing for non-core work, and they did not repeal the 60/40 rule (GAO, 1998).

Effective with the National Defense Act of FY 1998, the 60/40 rule was replaced by what is now the 50/50 rule. Although ten percent may not seem like much, put in the context of the $12 billion dollars spent on depot maintenance in fiscal year 1997 one understands the significant impact. The five significant effects of the act are as follows (GAO, 1998):

> 1) Provides for a new section 2460 in title 10 of the U.S. Code, which for the first time would establish a statutory definition of depot-level maintenance and repair. The definition includes depot-level work performed under interim and contractor logistics support arrangements, other similar contractor support arrangements, the installation of some modifications and upgrades, and certain software maintenance. It excludes the procurement of major system upgrades and safety modifications.
>
> 2) Amends 10 U.S.C. 2464 to provide for a DOD-maintained core logistics capability that is required to be government owned and operated. The provision requires that the core capability include the capabilities that are necessary for repairing new systems identified as requiring a core capability (except special access programs, nuclear carriers, and commercial items) within 4 years of the system's achieving initial operational capability.

3) Amends 10 U.S.C. 2466 to allow DOD to use up to 50 percent of its depot maintenance funds for private sector performance of the work.

4) Provides for a new section 2469a in title 10 of the U.S. Code containing special processes and procedures to be used in conducting competitions for depot maintenance workloads at the closing San Antonio, Texas, and Sacramento, California, depots.

5) Provides for a new section 2474 in title 10 of the U.S. Code requiring the Secretary of Defense to designate DOD depot-level activities as centers of industrial and technical excellence, adopt best business practices to improve their efficiency and cost-effectiveness, and provide for public-private partnerships at these activities.

The 50/50 rule has survived through the writing of this paper. Yet even at 50 percent, the level of work performed by the depots is criticized. According to Kennedy, Michael F. Camardo, executive vice president of Lockheed Martin Corporation, said that a "real constraint to productivity is the 50/50 rule" (Kennedy, 2001). Camardo asserts that the rule was intended to make sure the depots get enough work to stay in business, so that they are available for a national crisis, but "it is also intended to preserve jobs in the congressional districts where the depots are located" (Kennedy, 2001).

In addition, according to Butler (Butler, 2001) the Industry Logistics Coalition, an industry-lobbying group has argued against the 50/50 law entirely. They say that it is an artificial constraint on the Services' abilities to "effectively and efficiently manage depot-level maintenance and repair workloads" (Butler, 2001).

During fiscal year 2000, the Air Force failed to comply with the 50/50 limit. That failure reopened a fierce debate in Washington over how best to ensure the readiness of service weapon systems. According to Amy Butler in her article for Air Force magazine, "all tend to believe that the actions USAF leaders and lawmakers will take in the coming year to rebalance the workload distribution could redefine maintenance management for

the Air Force, which contains more aging aircraft than ever" (Butler, 2001). She states further that "Most officials in industry and government agree that the best way to ensure readiness is to maintain a mix of federal and contractor maintenance capabilities" (Butler, 2001).

This section described the history of the changing balance between public and private depot workload. Many factors and groups created the situation in the 1990's that first required government depots to receive 60% of all of DOD's depot work. This changed through the efforts of influential groups calling for complete commercialization of DOD depot work. This was followed by the repeal of the 60/40 rule and the establishment of the 50/50 rule. The current situation, in which the Air Force was unable to meet the minimum 50% requirement in FY00, has reopened the depot debate in Washington. The degree of change and uncertainty that continues to exist in the issue of depot vs. private source work loading creates uncertainty for what the future holds with regard to 60/40, 50/50, or any other combination of public/private workload rules.

Readiness and Inventory Levels

The purpose of this section is to show that 1) spares levels correlate to readiness, 2) pressures for lower inventories have come as a result of an emphasis on Lean Logistics, and 3) there is some evidence that spares levels may have come down faster than force structure, decreasing readiness.

In his 1999 research, Capt Gregory Hutson found a better method of forecasting total non-mission capable supply hours, the number of hours aircraft will be non-mission capable for want of a part from supply (Hutson, 1999). Currently, the Air Force uses a complex regression equation involving possessed hours, flying hours, and sorties. Capt

Hutson found a simpler, and more significant relationship between serviceable parts inventory levels and TNMCS rates for 8 of the 10 aircraft he studied; the F-15B, C, D, & E models; and the F-16A, B, C, & D; and NOT the A/OA-10 or the F-15A. These findings are simple and straightforward: NMCS and TNMCS rates are strongly correlated to the numbers of serviceable supply parts in inventory. Why then do these findings contradict the current explicit and implicit assumptions used the USAF?

The Air Force has been seeking inventory reductions for several years through a host of programs. Two of the most notable have been the "Lean Logistics" initiative in conjunction with the move to Two Levels of Maintenance (2LM; discussed later). In their report for the Air Force Research Laboratory, Barlow and Peasant provided this background on Lean Logistics (Barlow, 1998):

> The overall Lean Logistics goals are: a 50% reduction in cycle time for processes, a 30% reduction in material costs, and a 20% reduction in manpower. The term Lean Logistics was borrowed from manufacturing, where Just-in-Time inventory practices have eliminated or reduced parts inventories and their associated costs. Many industries are benefiting from this lean inventory approach. The U.S. Air Force wants to benefit in a similar way.
> Lean Logistics is an elaboration of the two level maintenance (2LM) strategy. Historically, U.S. Air Force maintenance has occurred at three physical levels: Organizational, where local personnel conduct remove and replace operations; Intermediate, where local personnel perform diagnostics and component repair; and Depot, where large-scale factory operations are performed. The 2LM strategy eliminates the Intermediate level and, therefore, base level spare parts and repair facilities are minimized. The 2LM strategy places a premium on rapid turnaround of repairable items at the depot and rapid transportation between bases and supporting depots. Since stock levels and repair facilities at bases are low (i.e., are lean), the logistics system must be far more responsive than it is now.

Research was unable to determine how the inventory levels of the Air Force have actually changed over the last ten years, however, according the Joint Staff's J4 website,

using constant 1995 dollars, inventory has gone from $107 billion in 1989 to $67 billion in 1996, a 37 percent reduction over 7 years. This inventory level is forecast to decrease to $48 billion by 2003, which would represent a 55 percent decline since 1989 (Joint Chiefs of Staff, J4, 2000). Worthwhile research would determine how these reductions have compared to personnel and equipment levels. Short of explicitly completing this determination, this research sought data detailing the results of this decrease in inventory. So far, any potential benefits have been underreported.

However, some counter-examples are worth discussing. The failure of the TF39 engine program is a well-documented example. According to Lipscomb, under 3LM, a production engine cost $665,000 as compared to $1.1 million under 2LM in 1997 dollars (Lipscomb, 1998). He says that a 1995 American Logistics Management Association study (AFLMA project LT9408800, Transportation Lean Logistics Initiatives) estimated that FY 1997 cost of the TF39 2LM program was $1 million more than the 3LM program. Two factors were cited as causing this increase in costs (Lipscomb, 1998).

1. BRAC closure announcements of the time and the general draw down in military personnel made it difficult for San Antonio ALC to find and retain qualified TF39 mechanics.
2. The decrease in reliability of the TF39 in the field. Reliability fell from approximately 1500 hours on the wing in 1992 to less than 500 as of 1997.

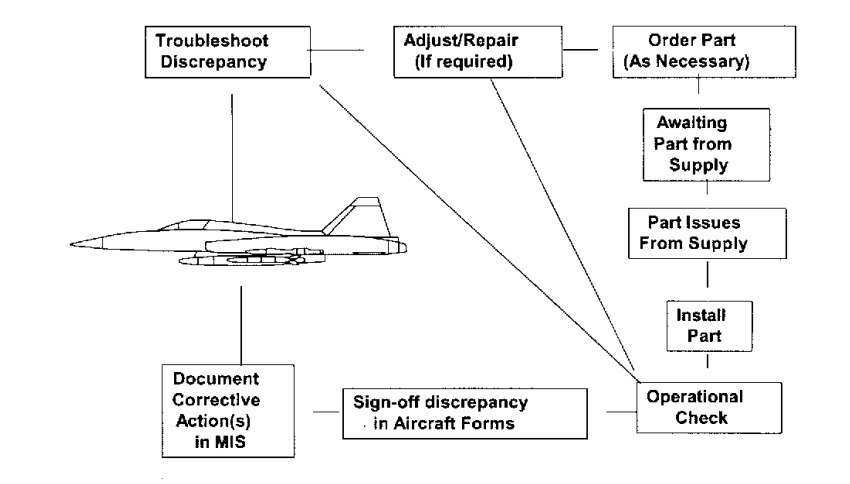
This section showed that 1) spares levels correlate to readiness, 2) that pressures for lower inventories have come as a result of emphasis on Lean Logistics, and that 3) there is some evidence that spares levels may have come down faster than force structure, decreasing readiness.

Description of Unscheduled Maintenance / Repair Process

Because of the detailed nature and highly specialized terminology involved with aircraft maintenance, the following section provides a detailed review of the unscheduled maintenance / repair process. Understanding these processes is an essential step in identifying opportunities to improve them.

The typical unscheduled maintenance and repair processes are explained in the Logistics Handbook for Aircraft Maintenance Managers (Labosky & Anderson, 1994). This process is described graphically in Figure 4, Unscheduled Maintenance/Repair Process.

Fig 5. Unscheduled Maintenance / Repair Process



During the unscheduled maintenance process, maintenance technicians typically work on the in-flight discrepancies reported by the aircrew. Once the discrepancy is identified, a maintenance technician is dispatched to begin repair. He/she is responsible for troubleshooting, ordering parts if needed, making necessary adjustments/repairs, installing parts, performing operational checks, and documenting the work performed in the aircraft forms and Maintenance Management Information System (MMIS).

Further problems arise when the part ordered from supply is not available. When this occurs the part is placed on backorder status. The Production Superintendent is notified of the backorder and asked to establish a backorder priority. Backorder priorities are established based on the effect the missing part would have on the ability of the aircraft to perform its assigned missions. Priority 1A is reserved for parts that make the aircraft non-mission capable, and JA for partially mission capable. The repair effort on the aircraft is placed on hold until the part arrives through base supply. In certain cases, the part will be obtained by cannibalizing it off another (typically already non-mission capable) aircraft. Once a replacement part is issued from supply, the discrepancy is repaired and the aircraft is returned to fully or partially mission capable status as appropriate.

Description of Typical Repair Cycle

The purpose of the repair cycle is to economically provide serviceable parts for the repair of aircraft. To accomplish this, the process must maintain control over assets while maximizing base repair capabilities, thereby saving taxpayer dollars. Another characterization of the repair cycle is that it exists to repair aircraft parts and return them to service as quickly as possible. The base level repair cycle is a revolving process that begins when Maintenance orders a repair cycle asset from Supply. It continues with base-level maintenance repair actions and ends when a like asset is returned back to Supply.

Discussion of the repair cycle begins by discussing what types of parts are in the repair cycle. By categorizing parts by their authorized source of repair, the repair cycle is able to operate more efficiently. Otherwise parts would show up at repair shops that were

unable or unauthorized to perform the repair and they would continue to be moved around until they found the right place. Parts that are repaired (reparables) and not simply disposed of and replaced (consumables or expendables) are coded with an Expendability Recoverability Reparability Code (ERRC) of XD or XF. "Typically, these are supply items whose high procurement costs make them candidates for local or depot repair rather than allowing them to be thrown away and buying new ones" (Labosky, 1994). While the determining factor for whether a component is coded as XD or XF depends upon the highest level of repair required (XF for field and XD for depot), there is also a correlation between the levels authorized to condemn the part. These relationships are graphically depicted in Figure 6, Repair Cycle Responsibilities.

Fig 6. Repair Cycle Responsibilities

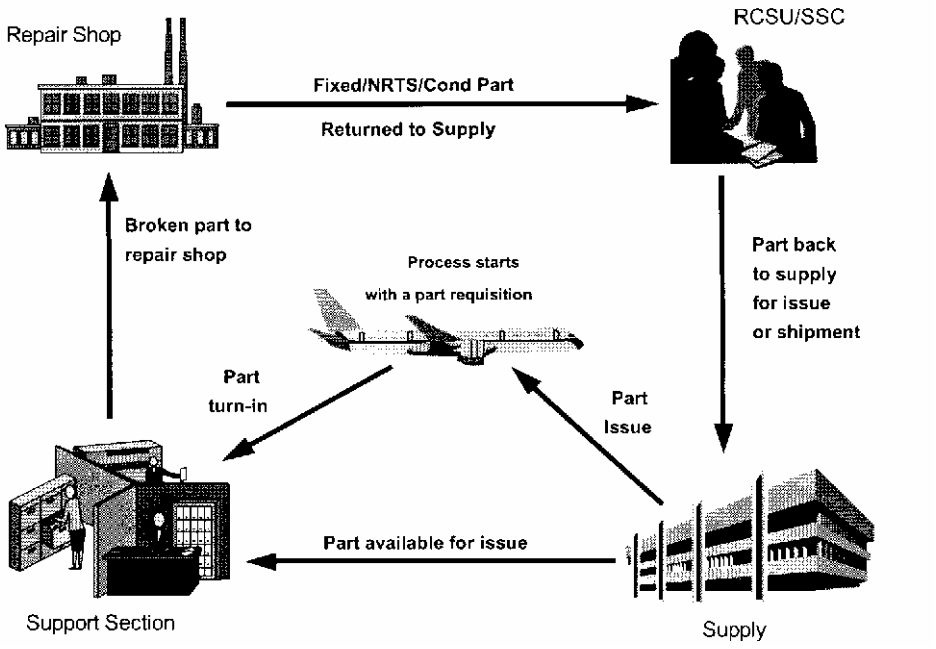


Figure 6 is an illustration of the repair cycle responsibilities. It shows the relationships between the supply person in the support section who orders the part; the

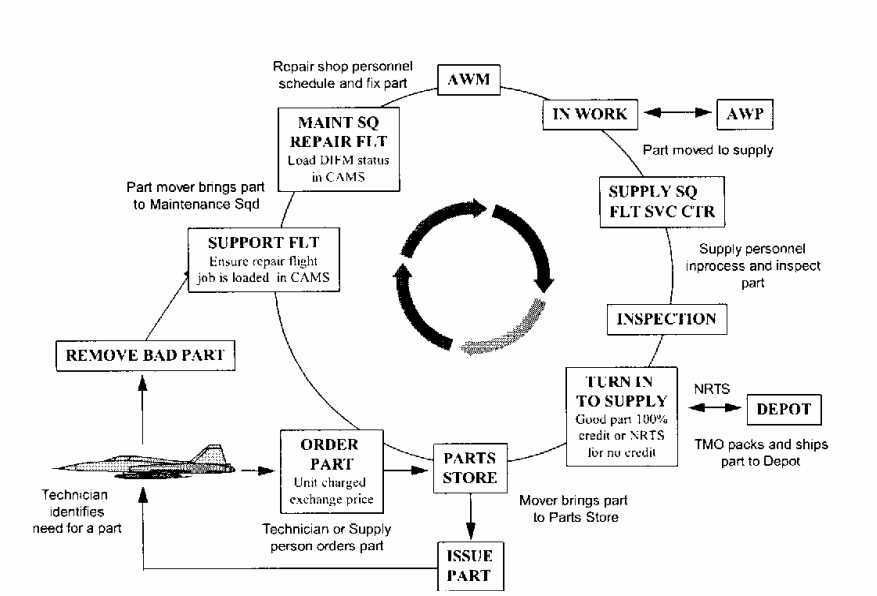
repair shop personnel who schedule and repair it; the parts mover responsible for moving the asset between shops and then to supply (either the Shop Service Center, Repair Cycle Support Unit, or local repair processing center); the supply personnel who process the paperwork to turn in and warehouse the asset; and the transportation personnel who pack the asset and ship it to the end location (Labosky, 1994).

In order to ensure accountability for parts from supply, when a repair cycle asset is issued or backordered, base supply establishes a Due-In From Maintenance (DIFM) detail. This means that a requester owes base supply an item in exchange for the item the requester received (Labosky, 1994). Otherwise, inefficient or irresponsible organizations could 'warehouse' their own parts to ensure their own readiness at the expense of the rest of the Air Force.

There are three categories of repair cycle actions or "DIFM status codes". They are: (1) Items undergoing repair; (2) Items awaiting parts; and (3) Items that are intentionally not being worked (delayed maintenance).

This background information about unscheduled maintenance, ERRC codes, and the DIFM process provides the foundation for the simplified view of the repair cycle shown in Figure 7 on the next page .

Fig 7. Repair Cycle Process Overview



The repair cycle process begins when a demand is placed on Base Supply for a reparable asset. If the part is available, the broken part is "exchanged" for immediate issue of a replacement asset. Sometimes, if no replacement is available, the unit must wait for that specific asset to be repaired either in the local backshop or by a depot, this is known as a "return". The following excerpt explains in detail the repair cycle process (Labosky, 1994):

> Typically, the "broke" asset goes to the repair shop and is placed into a holding status where it is placed on a repair shop schedule. This time in "holding status" is referred to as awaiting maintenance (AWM) time. Next, the repair technician works on the asset. However, sometimes the repair technician will need to order component parts or bits and pieces to repair the asset. The asset will then be placed in awaiting parts (AWP) status. Once the technician receives the bits and pieces, repair on the asset can resume, and the asset turned back in to Supply. If the asset turned in to supply is in serviceable condition (repaired), it will be placed back on the shelf awaiting the next demand. However, if the repair technician could not repair the asset (not reparable this station (NRTS), the asset will be returned to a repair facility (depot), based upon the destination identified by the Reparable Item Movement Control System (RIMCS) code. If the asset is condemned (XF assets only), it will be shipped to the servicing Defense Reutilization and Marketing Office (DRMO).

Once Maintenance requests a replacement asset from Supply, the broken asset is automatically entered into the repair cycle process by the base supply computer. The repair cycle asset flow has basically four steps:

1. The broken part is turned in to the support section/materiel control where the appropriate paperwork is filled out.
2. The broken part is routed to the repair shop to troubleshoot the malfunction.
3. The repair shop either repairs, NRTS or condemns the asset and routes it to Supply for turn in processing.
4. Once the turn in is processed, the asset is returned to Supply where it is either put back on the shelf as serviceable to satisfy a future demand or prepared for shipment to an off-base repair activity.

Once the maintenance technician initiates action to obtain a replacement item, they normally turn the broken item into the materiel control function. The folks in materiel control match the unserviceable asset up with copies 3 and 4 of the DD Form 1348-1, Issue/Due-Out Release Document, which was output by supply's computer when the issue request was processed. Maintenance, using information on the output DD Form 1348-1, will fill out an AFTO Form 350, Reparable Item Processing Tag in order to provide the repair shop with information concerning the broken item.

The AFTO Form 350 and the unserviceable item then go to the applicable repair shop for processing. Sometimes, an asset requires maintenance in more than one shop. In that case, it is the responsibility of the maintenance shops to coordinate with one another in the repair of the item and in maintaining updated DIFM status and location codes. The repair shop scheduler reviews the discrepancy of the item and schedules the asset for repair. Shop scheduling is usually determined by the maintenance priority code and the stockage position of the asset as reflected on the Repair Cycle Asset Management List (D23). Maintenance priority codes 3, C, L and T indicate the asset is either AFMC, MAJCOM or base critical and therefore needs to be repaired or shipped off base for repair as quickly as possible. Likewise, if the asset will restore an end item to mission capable status then it should be afforded priority repair action. If the local repair facility cannot repair the asset or does not have condemnation authority, as determined by the ERRC, the repair shop will declare the asset Not Reparable This Station, (NRTS) and turn it back to Base Supply who processes a turn-in and sends it to transportation for shipment to the appropriate repair facility which in some cases may differ from the source of supply. Reparable Shipment Destination Codes are assigned to reparable items to tell base supply where the item is to be shipped for repair. These codes are provided through the Stock Number User Directory (SNUD) and will also designate the shipping priority of the DIFM carcass.

Once the repair shop completes their actions they should forward the serviceable or unserviceable item along with the AFTO Form 350 and copies 3 and 4 of the DD Form 1348-1, Issue/Due-Out Release Document to the applicable Reparable Processing Center (RPC) where Supply personnel pick up both the property and the documents. The supply representative will acknowledge receipt of the item by signing and dating copy 4 of the original issue or due-out release document (DD Form 1348-1). RPC personnel should retain this signed copy to verify the property returned to base supply. Supply personnel review the documents accompanying the property to ensure they are complete. Any entries that are questionable or incomplete on the AFTO Form 350 will be promptly coordinated with the applicable maintenance RPC for clarification and correction. Specifically, Supply will ensure that block 16 of the AFTO Form 350 contains the same document number that is on copy 3 of the DD Form 1348-1. Also, block 20 of the AFTO Form 350 must contain the authorized action taken code that accurately describes the action maintenance took on the item. Three copies of an AF Form 2005 will be prepared for each DIFM item turned in through supply. When the turn-in is processed, it will update the item record and the repair cycle record. Input of an action taken code will update the action taken code field.

The repair cycle ends when the turn in is processed and the DIFM detail deleted. Occasionally, however, an unserviceable asset may need to be repaired and reinstalled on an end item without going through base supply. Or, the unserviceable item may only need calibration or bench check before it is reinstalled. Items processed in this manner are known as maintenance turnarounds.

When Maintenance repairs and reinstalls a repair cycle item on the aircraft or end item and does not physically process it through supply, a confirmed (verified) demand is not placed on supply. In this case, Maintenance will furnish sufficient data to Supply to process documentation for recording demand and repair cycle data on the item. Supply uses the information provided on the AFTO Form 350, Part 2, to prepare and process a maintenance turnaround record update which will update demand data on the item record and update repair cycle time on the repair cycle record. We cannot overemphasize the importance of processing TRN data! The processing of a TRN provides the same demand data generated as if a serviceable asset had been issued from Supply and Maintenance had repaired and turned in the assembly that failed. Failure to process TRN data in a correct and timely manner results in reduced base stock levels and incomplete reports from which buy, repair, and distribution decisions are made by AFMC. Only close coordination between Maintenance and Supply ensures the generation of stock levels required to support the base repair cycle

The repair cycle is designed to economically provide serviceable parts for the repair of aircraft. It accomplishes this maintaining control over assets while maximizing base repair capabilities, thereby saving taxpayer dollars. One may also say that it exists to repair aircraft parts and return them to service as quickly as possible. The base level repair cycle is a revolving process that begins when Maintenance orders a repair cycle asset from Supply. It continues with base-level maintenance repair actions and ends when a like asset is returned back to Supply.

Conclusion

In this chapter, we have presented the need for improvement in the supply of repair parts for aging and complex aircraft and the problem of changing policies on the extent of public depot repair. In addition, the current unscheduled maintenance and repair cycle processes have been explained. To evaluate possible future alternatives in performing unscheduled maintenance, agreed upon measures should be determined. The purpose of the next chapter is to explain the methodology this paper used in identifying these issues.

III. Methodology

Overview

The subject of this research topic has not yet been thoroughly or formally investigated. Therefore, the primary source of information used in this effort came from expert opinions, captured through informal personal interviews. Additional secondary sources consist of theses, reports, and journal and newspaper articles. The purpose of this effort is to identify the key issues involved in the repair part source selection decision. Once these issues are initially identified, it is hoped that a more objective analysis will be possible.

Primary Sources / Expert Opinions

An expert panel was assembled to discuss issues relating to alternatives to unscheduled maintenance. This panel was selected based on their vast special operations experience and detailed knowledge of the logistics system.

The panel was also available to discuss findings from the more objective secondary sources. Their flexibility was also essential in helping to evaluate the constantly changing environment of the Air Force logistics system. Extensive discussions and exchange of e-mail on the published results of the Chief of Staff of the Air Force's Logistics Review is but one example.

The panel consisted of Col John Easley, HQ/SOCOM Director of Logistics, Center for Acquisition and Logistics; Col Kent Mueller, HQ/AFSOC Director of Logistics; Lt Col Paul Webb, Commander 352 MXS; and Mr. Franklin Spinney, an analyst in the Pentagon's Office of Program Analysis and Evaluation. With the exception

of Mr. Spinney, the members are very familiar with the operations at the 352d Special Operations Group and the 352d Maintenance Squadron.

The development of topics with the expert panel was an iterative and evolutionary process that occurred over the previous year. During e-mail and phone discussions with the panel of experts, ideas were bounced back and forth discussing what were the most important issues in assessing the cost benefit analysis between the SOG's method and the conventional Air Force. Whenever the originator's responses to this informal interview process were planned on being used, they were given the opportunity to correct and/or change their response. All of the e-mails have been retained by the author and are available upon request.

Secondary Sources

Content Analysis is a research tool used to determine the presence of certain words or concepts within texts or sets of texts. By quantifying and analyzing the presence, meanings, and relationships of these words and concepts researchers make inferences about the messages within the texts.

The volume of literature collected and reviewed was sourced through searches for "unscheduled maintenance", "source of repair", and "source of supply." Other items were added on a case-by-case basis when referenced by one document or recommended by one of the members of the expert panel.

The content analysis for secondary sources followed the following four steps. First, the level of analysis was determined. Because numerous regulations were going to be reviewed, and because regulations tend to be repetitive and written for thoroughness rather than readability, a simple word count was assessed to not be the most effective

means of measuring the magnitude of the reading's application to various topics. Instead, after reading each piece of research, the author assessed it's applicability to the various topics being sought.

The second step was to begin reviewing the collected work of research. As each piece was reviewed its main topics were written down and added to the cumulative list of topics. As further items were reviewed their topics were added to the list where appropriate and if they reviewed previously listed topics that topic was marked as being reviewed again. Included with this step was a quality-check for an actual discussion of the topic and not merely mentioning of the issue. When an issue was relevant to the writing of this paper, but not necessarily to the issue of alternative procedures in unscheduled maintenance it was marked as "other".

The third and fourth steps were to put the results of this survey into a table format, and perform a tally for frequency of occurrence for each topic. The results are shown in Chapter IV and Appendix B.

This chapter described in specific terms the method of the content analysis conducted, the qualifications of the expert panel whose opinions helped form this paper, the method of the 'interviews' conducted, and in general terms the nature of the secondary sources researched. Because this search combined an objective review of many different sources of many different types, with the textured and mentored advice from this expert panel, it is hoped that the list of topics generated is relevant and credible.

IV. Data Description and Analysis

Overview

This purpose of this chapter is to present the findings (identified issues) of the expert panel, detail the results of secondary source content analysis in Table 1 and Appendix B, and present excerpts from the secondary sources that contributed to the developing main theme that aircraft spare and repair parts have been reduced below levels required to sustain current infrastructure and opstempo – impacting abilities to efficiently and effectively perform unscheduled maintenance. Evidence of this proposition is presented in the form of NMCS and Cannibalization rates for the C-5, KC-135, and KC-10; and by C-130 MC and TNMCS rates. A review of one source that looked at public vs. private parts sourcing is presented and their conclusions reviewed. After a short review on the allocation of fixed costs and the implications towards long term sustainability for government depots this chapter concludes with an identified weakness in the lack of sources suggesting the applicability of the SOG's experience with expendables to the reparable process.

Expert Panel Findings

The ongoing discussion among the expert panel has been diverse all year long. Each member provided distinctly fascinating opinions. Col Mueller suggests that investigation of 2LM would reveal that it has "flopped", that the 50/50 rule is a "stumbling block" to expanding depot initiatives, that supply chain management is the latest "darling" in Washington, and that advancing technology made the depots obsolete. Col Easley described how he took some of the SOGs processes and implemented them at

Little Rock AFB with great success. The heart of these processes has been obtaining alternative sources of supply. He also mentions airframe availability and cost reduction, production planning and execution, resource synchronization, and upcoming Best Value Analysis being performed on the CV-22. Lieutenant Colonel Webb describes the SOGs determining factor when using civilian contractors to provide expendable aircraft parts, "it's never been money", and describes the level of support from those contractors as "embarrassingly top-notch". Mr. Spinney contributed relevant contradictions in long-held notions about "protecting the industrial base."

Col Mueller: Col Mueller's previous jobs at Warner Robins have given him keen insights into their problems and how they can improve.

> The real results of 2LM will be hard to track down, cause much of it flopped, and the politics involved in "bringing that to light" would be like Watergate!
>
> Title 10 United States Code, Section 2466, "the 50/50 rule" essentially states that not more than 50 percent of the depot funds can be expended with contractors.... read as must be organic. That is a stumbling block to greatly expanding contract Depot Agile Response Team (DART). Organic DART is being worked in a project by Dan Mattioda at AFIT right now.
>
> Supply Chain Management (SCM) is a current "darling" in Washington and is largely an "unexploited" field of study in the public sector (military retail and wholesale). The idea is that we have focused pretty well on repair point management, but have neglected where we put items, how we account for them, how we process them, etc. I think if you zero in on Pin Point Delivery, Direct Vendor Delivery, and other SCM ideas you might find more stuff that you can spin into a project. Take a look at this book: Supercharging Supply Chains, new ways to increase value through global operational excellence, by Tyndall, Gopal, Partsch, and Kamauff
>
> Here's another idea. If you can find the 2LM source documents and drill down into the assumptions, and if you can find that (this is true) the technological and economy of scale assumption was that "advancing technology" made the "intermediate level mx" obsolete, and high velocity pipelines created economical 2LM depots you might have a "bone to chew

on" so to speak. Here's why I say that. The pipelines never got funded. The advance of technology, especially digital troubleshooting and repair has now leaped forward to the point that almost any repair can be done at the unit (with NO pipeline). IT HAS MADE THE DEPOT and its pipeline obsolete!!! But in the mean time, the funding policies and regulations are all crafted to support reimbursement of the working capital fund (WCF), which is disbursed to the services. In the AF it makes up the Materiel Support Division (MSD), which provides obligation authority to the SMAG supply maintenance activity group stock funded repair and procurement effort. The objective is reimbursing the stock fund, NOT more products at reduced total ownership cost (TOC)!!!! So, the innovators and revolutionaries are fundamentally at odds with the stock fund in trying to improve readiness at reduced cost!!!

Col Easley: Col Easley's final comments included these:

When I became the Log Group commander at Little Rock in 1998 I brought with me this perspective of the world. The first thing I saw was how our kids in the MICAP section in base supply were struggling. When item managers were zero balance on a part they would give our young supply troops backorders with ridiculous EDDs attached. You can imagine we not real popular with the flightline maintainers. One of the first things I did was authorize base supply to pay for the access fees to commercial databases like "Haystack". Then when the item manager said zero balance and the EDD was more than say 30 days, our MICAP section could surf the web and often find a commercial source. Now the part was rarely the same price or cheaper than the organic depot, but what is the price of a grounded aircraft. We would get approval from the squadron for the increased price, and the engineering approval from the depot and with the IMPAC card our supply squadron started to make magic happen. Almost from the start the results were impressive. In fact Little Rock still enjoys the lowest MICAP rates of any active duty C-130 unit (Yokota, Ramstein, Pope, Dyess). I know I tracked them and compared stats for almost two years. Part of the reason for this success is giving the supply troops in the base supply the tools they need and the chance to do their jobs. No one else in AETC seemed interested in what we were doing. In fact the rest of the Air Force is going the other direction. Across the MAJCOMS base level MICAP sections are being disbanded the regionalized into headquarters. Everywhere this has been implemented you can see the NMCS rates rise. In the mid to late 80s I was attending the national convention of Maintenance Officers Association (forerunner of the Logistics Officer Association) and I had the opportunity to listen to Gen Leo Marquez and he said something that has always stayed with me. It went something like this..."People fly airplane, they break and someone else has to fix them. It's just that simple, yet we try to make it tougher than it needs to be by confusing it with fancy terms, acronyms and double

speak". Now that may not be how he said it, but that was how I heard it and I think he hit the mark. It is that simple, yet we try to make it more difficult than it needs to be. It is all about fixing planes. Doesn't matter if you are in base supply, contracting, transportation, maintenance it is about fixing planes so they can do the missions as they were intended. As leaders we are supposed to be empowering them, giving them the tools they need to do their jobs better, smarter faster. It should never be just about money. If we ever make the cost more important than readiness then we have lost sight of our mission and the relevance of a separate service dedicated to airpower.

Other topics that have been important to Col Easley this year included:

- Airframe availability and cost reduction;

- Production planning and execution, and;

- Resource synchronization issues

Other comments are great lead-ins for recommendations for further research,

On a different note I am sure you are aware of the Best Value Analysis (BVA) being performed on the CV-22 program. They are considering four centric approaches: Air Force centric, Navy centric, contractor centric and an AFSOC centric. As you may guess the last one is Kent Mueller's brainchild. It is a unique approach to sustainment for the CV-22. It would place contractor and program manager at Hurlburt, with an intended purpose of forming a cohesive team. Contractor, program management and user all at one location. Only time will tell if he will be successful in this concept. (Easley, 2001)

Lt Col Webb: An informal interview was conducted with Maj Webb while he was in

Washington D.C., notes of the interview are included below:

Q. Does the 352 MXS have a standard procedure for handling unscheduled depot-level MX (UDLM)? (Private v Public)
A. Yes, we always attempt to go to the public depot first, then, when it can't support the mission, look to alternatives.

Q. Can you rank order the criteria in determining when you go private? (money, time, etc.)
A. It's never been money, but ship time and availability of parts both weigh in. And when both are better with the private depot, well, the decision is way too obvious.

Q. Who do you use in the private sector?

A. Marshall's of Cambridge, Kearsley Airways at Stansted, C-130 dot com, Agusta, and a South African company I can't think of right now.

Q. How has their performance been?
A. Embarrassingly top-notch.

Q. How can each (public and private) depot improve their performance?
A. Marshall's are really top-notch; public depot is so political it makes me sick. Marshall's is spring-loaded to help us out, Warner-Robins is not competitive. Warner-Robins thinks that our business is their God-given right.

Q. Can you compare (public and private) depots in terms of cost benefit analysis?
A. Yes…the private depots are much more responsive and occasionally cheaper too.

Q. How about some anecdotal examples?

- There was the gunship with leading edge problems; Marshall's made the brackets for us.

- Pave 1652, Augusta helped us change the tail on it at Brindisi

- Pave 5784, hard landing…. the RAF airlifted it for us and charged us lunch and Budweiser

- RAF Lynham repaired the C-130 aileron toque tube and charged us a case of Budweiser

- Talon 0023, over speed, needed a truss mount. WR said it would take 3 weeks; Marshall's got it for us in 5 days from the same supplier and for $3,015 less!

- Radar blowers on the Talons, WR could never find a contractor to replace them. Kearsley borrowed a sample from us, digitized the information, and is now replacing them for us.

Q. Do you have anything else I haven't mentioned?
A. Yes, I just wanted to point out that we're using these private depot-level firms more than just as a supplier, they've also been used for services and expertise as well. Marshall's has come to us several times with, "you guys have been doing this C-130 thing much longer than we have, how did you solve…" More often than not, it's something we haven't solved or haven't even thought of yet, all too often, we've gone to them as the experts.

Mr. Spinney: When it comes to costs, Spinney is notable for his criticism, and

convincing arguments against seemingly wasteful practices. Spinney made the following

comments in his article, "Front Loading the C-130J…What Does 'Protecting the Industrial Base' Really Protect" www.infowar.com/iwftp/cspinney/c154.txt, dated 1998:

> "Protecting the industrial base" is, of course, a major defense policy, as well as a hackneyed argument for justifying unneeded procurement programs, like the Seawolf submarine. The central idea is that we must buy an unneeded product today to preserve the capacity to produce that product tomorrow, should we need it.
> …In fact, examining the consequences of North Georgia's feeding habits (i.e., cost growth w/o meaningful capability changes) goes well beyond the trite industrial base argument. It will help to put another piece into the puzzle of understanding why a $265 billion defense budget produces a
> (1) high-cost modernization program that will not modernize the force,
> (2) a rapidly declining readiness posture, and
> (3) a corrupt accounting system that make it impossible to fix the first two problems.
> …Pincus (Walter Pincus of the Washington Post) notes that only 5 of the last 256 C-130s Congress appropriated for the Air Force or the National Guard were actually requested by the Air Force.

What could he be talking about with regards to the accounting system? To borrow briefly from the secondary source review, one area that is benefiting from the implementation of commercial business practices is in the depot's accounting systems. The current systems were designed in the 1960s and although they do what they were designed to do (record commitments, obligations, and expenditures), they are not designed to be Chief Financial Officer (CFO) compliant, they are not transaction driven, do not track all assets, and do not produce accurate financial statements. As a result, today we are sometimes unable to know what we own or how much we paid for it. And, appropriate to the discussion of competing public versus private workloads, we are often unable to determine what it costs to run the business of depot maintenance. The solution is the upcoming implementation of the Depot Maintenance Accounting and Production System (DMAPS). The three objectives of this system are to:

1) Improve Financial Management;

2) Move Towards CFO & Cost Accounting Standard (CAS) Compliance; and

3) Reduce the number of Air Force and Defense Finance and Accounting Service (DFAS) legacy systems. As of 4 May 2001, it was scheduled to be fully operational by 1 October 2002 (Depot Maintenance Accounting and Production System, 1999).

Analysis of discussions with the expert panel produced the following list of topics:

- Readiness: Above all else, changing procedures must result in improved readiness.
- Cost: This can be measured in several different ways:

-- Cost to the squadron

-- Cost to the Air Force in terms of increased allocation of depot's fixed costs on the remaining inventory (cost shifting).

It was recognized that certain costs are not capable of being measured. There is certainly some cost to the lack of standardization within the Air Force, but there is also a cost associated with the lack of flexibility. Resolving these issues was beyond the scope of this effort.

Another issue identified was the cost of not making improvements to the way depot does business. This is roughly comparable to a discussion about what would the American car industry be like if it weren't for the competition provided by the Japanese? It's been said that we'd still be driving K-cars if it weren't for the competition the Japanese manufacturers provided. By analogy it is hoped that by increasing the competition between depot and industry that both will improve and become better.

The previous section discussed some of the topics raised by the expert panel over the previous year. Col Mueller suggests that investigation of 2LM would reveal that it

has “flopped”, that the 50/50 rule is a “stumbling block” to expanding depot initiatives, that supply chain management is the latest “darling” in Washington, and that advancing technology made the depots obsolete. Col Easley described how he took some of the SOGs processes and implemented them at Little Rock AFB with great success. The heart of these processes has been obtaining alternative sources of supply. He also mentions airframe availability and cost reduction, production planning and execution, resource synchronization, and upcoming Best Value Analysis being performed on the CV-22. Lieutenant Colonel Webb describes the SOGs determining factor when using civilian contractors to provide expendable aircraft parts, “it’s never been money”, and describes the level of support from those contractors as “embarrassingly top-notch”. While Mr. Spinney has a go at long-held notions about “protecting the industrial base” that required some additional information about the depot’s accounting systems.

Secondary Source Content Analysis

128 secondary sources were analyzed for identification of key issues involved in the sourcing decision. Ten topics were identified as common to many sources. The ten issues are provided in Table 1, rank ordered by the frequency of the topic covered. The category “Other” represents the number of sources that were researched that answered a specific question unrelated to the other topics indicated.

Table 1. Number of Occurrences for Each Topic

Depot Maintenance	62
Costs	61
Readiness	52
Other	30
Privatization	26
Logistics Review / Transformation	25
Outsourcing	23
Lean Logistics	20
Contract Logistics	17
Two-Level Maintenance	6

Each topic was counted for how many of the 128 secondary sources reviewed discussed that topic in making improvements to the unscheduled maintenance of aircraft. The most frequently occurring topic was Depot Maintenance as defined in Chapter I.

The second most frequent topic was Costs. These costs can have numerous different applications as it may relate to taxpayer costs, direct costs, and overhead costs to name but three examples.

The next most frequent topic was Readiness. Typically this is meant as an indication of the weapons systems mission capability rating over time; or the percentage of time the weapon system is mission capable.

As discussed earlier, 'Other' topics were unclassifiable specific questions that were answered in preparing, formatting, and providing the necessary background for this paper.

'Privatization', the next most frequently occurring topic denotes the process of transferring the performance of a task from a government organization to a private contractor.

'Logistics Review / Transformation' represents the Chief of Staff of the Air Force's logistics review and the subsequent call for 'transforming' organizations and processes.

'Outsourcing' the next most frequently occurring topic, is systematically using private contractors to provide a small part of a complete process.

'Lean Logistics' here has the same definition as in Chapter I.

'Contract Logistics' was defined for purposes of this paper as any contracted logistics services unrelated to 'outsourcing' or 'privatization'.

'Two level Maintenance' has the same definition as in Chapter I.

Excerpts from Secondary Sources

The following excerpts from secondary sources have been included because they support the main, unproven issue of the proposition that spares were reduced more than we reduced infrastructure/opstempo. The negative results are shown in the following excerpts:

Conetta attributes sharp declines in readiness in 1997 and 1998 to three sources, two of which have already been discusses earlier in this paper (Conetta, 1999):

1. There are insufficient parts in the pipeline, although Conetta attributed this to unexpected demand and understated requirements; and

2. Excessive infrastructure

In a report for the Project on Defense Alternatives, Conetta, et al, said:

> Without question, key indicators of USAF readiness registered significant declines in 1997 and 1998. Our review of the Air Force's recent readiness problems traces them to three principal sources:

> (i) Unexpected demand for spare parts in 1996 and an understatement of the requirements for parts in 1997 that left insufficient parts in the pipeline for 1998,
> (ii) Imprudent choices in the management of pilot inventory during the draw down earlier in the decade, resulting in pilot training levels well below sustainment levels, and
> (iii) The burden of carrying excess infrastructure – i.e. bases that the service neither wants nor needs.
> As a result of a temporary spare parts shortage there has been an increase in the rate of cannibalization of aircraft for parts. This problem is partially mitigated by a substantially greater buffer of spare planes available today than during the Cold War. …Since 1991, the Mission Capable Rates for the service's aircraft fell 10 percentage points to a current level of 74%. Almost one-third of this decline occurred in 1998 alone (Conetta, 1999).

Capt Kenneth Bowling identified problems with the acquisition system in his article for the Air Force Journal of Logistics titled, "Military Readiness and Outsourcing Depot Repair." This citation is added here for the value of his last point, that contractors are intimately involved with the process of determining if maintenance and repairs are contracted out. Clearly there are problems with insufficient checks and balances when the contractors are helping to write the analyses determining source of repair.

> A second problem is that Development System Managers (DSMs) are advocates for their single system, not the Air Force as a whole. A putting *rubber-on-the-ramp* mentality, and real political pressures did not go away with the introduction of IWSM. ISMs are faced with tremendous pressure to field their systems arguing that without a *cradle* who needs a *grave*? Logistics support considerations are often ignored. This places greater risks on ownership costs for the gaining commands and threatens long-term readiness. Further, it flies in the face of Defense Acquisition University guidance that, during the system engineering process, long-term logistics support considerations should be equal to cost and performance considerations.
>
> PROBLEM CAUSES: There are four problems in the SORAP process that lead to these problems.
> 1. *Best Value* is ambiguous and lends itself to misapplication for near term gain pressures to field a system or modification without delay, despite known logistics concerns.
> 2. Premature SOR determinations. The SORAP manual states, "It is essential that actions required to obtain a SOR decision be taken as early as possible to avoid the expense and program turbulence associated with

protecting both options until a decision is made." However, it also states that, "life-cycle support decisions are made early in the design…rather than waiting until after the design is completed." However, if we plan to have no organic repair for an item and the design is substantially altered and/or logistics analyses prove inaccurate, the unprotected option becomes far more expensive than it would have been if we had "protected both options".

3. Single managers perceive investments in new repair technology at an ALC as a burden to their program. Then, when repairs are required, contractor estimates are lower than the public depot's because they can do it without any up-front investment because it already owns the capital equipment, facilities, and skilled labor. The contract is awarded sole-source to the original developer, and the life-cycle risks jump another notch. The investment decision would have provided lower life-cycle costs for multiple weapon systems. Here is an example of the best value loophole in effect. The investment decision is decided against, but it was measured only in that year. The lost savings in out years would have provided needed funds for future modernization. Additionally, it would have kept the ALC current on new technology, instead their relegated to "antique fixer and dealer status".

4. Prime contractors complete the logistics support analyses (LSAs) that help decide if repairs are to be contracted out. First of all, decisions of the SORAP are often completed before LSAs are mature; secondly, these prime contractors stand to gain the most if repairs are contracted out! (Bowling, 2000)

There may be problems with insufficient checks and balances when the contractors are helping to write the analyses determining source of repair. However, since the organic capabilities of the Air Force have already been cut so far back, there may be no recourse (see the F-117's depot support contract in the studies that already looked at public vs. private parts sourcing later in this chapter).

As noted earlier, some sources have been calling for increased cuts in infrastructure. This action would contribute to the goals of this paper if those cuts in infrastructure resulted in cost savings that could then be applied to increased spare and repair parts in the pipeline.

There are others who would argue that readiness could be best improved by decreasing the infrastructure of the United States Air Force. In fact, that's exactly what the commander of Warner-Robins Air Logistics Center was reported as saying in a 4 October 1998 Associate Press article. "Air Force Maj Gen Richard Goddard says the base under his command is suffering from overused jet parts, disenchanted employees and aging equipment" and that military readiness has "steadily and dramatically" declined since the Gulf War (Simard, 2000). Goddard said the meeting was the first in an effort to improve military readiness, which Goddard said has "steadily and dramatically" declined since the Gulf War. These comments are similar to those raised in an article about the testimony of Gen Babbitt, Commander, Air Force Materiel Command. In his October 1999 testimony before the House Armed Services Committee, General Babbitt stated, "The readiness of Air Force weapons systems has been jeopardized for several years by the lack of spare parts and repair parts. Since 1991, the Air Force has experienced a steady decline in aircraft mission capable (MC) status from an average of 83 percent to an average today of 73 percent" (Simard, 2000).

This review of citations from the secondary sources showed at least one more source stating that the Air Force

1. Has/had insufficient parts in the pipeline, although Conetta attributed this to unexpected demand and understated requirements; and
2. The Air Force has excessive infrastructure

It also reviewed problems with insufficient checks and balances when the contractors are helping to write the analyses determining source of repair. And, as noted earlier, some sources have been calling for increased cuts in infrastructure. This action would

contribute to the goals of this paper if those cuts in infrastructure resulted in cost savings that could then be applied to increased spare and repair parts in the pipeline.

Supply Availability vs. Readiness

The issue of supply availability vs. readiness is further supported with two GAO reports, "Air Transport Capability Falls Short of Requirements" (GAO, 2000) and "Updated Readiness Status of U.S. Air Transport Capability" (GAO, 2001).. The lack of sufficient spares is evidenced by Non-Mission Capable Supply (NMCS) and Cannibalization rates for the C-5, KC-135, and KC-10 weapon systems for Fiscal Years 1997-2000 and by unacceptable (more than 50% of the time for ACC and AMC) Mission Capable and NMCS rates.

The comparison of KC-135 NMCS and Cannibalization rates is shown in Figures 8 and 9. Additional figures for the C-5 and the KC-10 are included in Appendix C.

Fig 8. KC-135 NMCS Rate

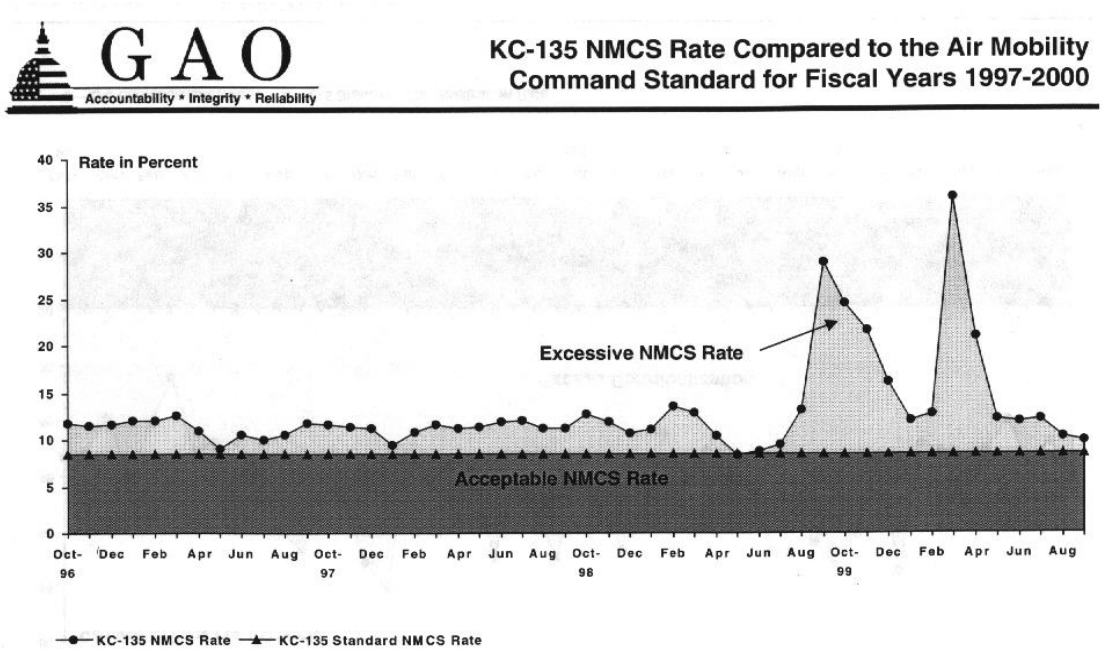
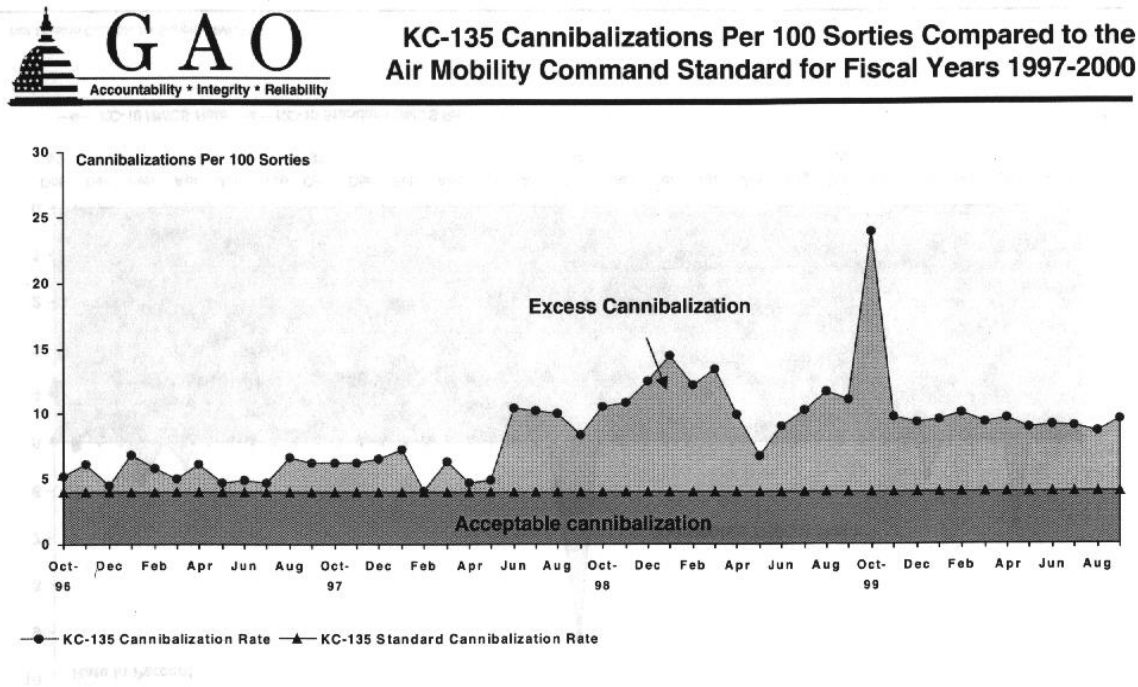


Fig 9. KC-135 Cannibalization Rate



What is evident looking at the KC-135 is that cannibalization rates go up with increases in NMCS time. The reason for this is intuitively obvious; when spares are not available from the supply system, maintenance troops will seek to improve readiness by taking the parts off of otherwise deadlined aircraft. This raises the issue of the increasing costs of maintaining weapons systems when spare/repair parts are not available. Rather than being able to remove the bad part and install the good replacement part, units must remove the bad part, and remove a good part off another aircraft, install the good part on the broken aircraft, and typically reinstall the bad part in the canned aircraft so as to not leave a "hole". Once the replacement part is issued, the bad part is removed again and the replacement part installed. One can see in this simple scenario how cannibalizing can mean expending three times the maintenance labor effort than if parts were available. Although the C-5 and KC-10 slides do not as clearly show the linkage between

cannibalization rates and NMCS time, both slides together indicate the problem with unacceptably low inventory levels (GAO, 2001):

These slides may also show evidence of a benefit to using private contractors for depot maintenance, as in the case of the KC-10, versus public depot support for the KC-135 and C-5. While the KC-10 Cannibalization rate at times exceeded the acceptable levels, it was at least cyclical as compared to the C-5 and KC-135 which were consistently in excess of the acceptable rate. The KC-10's NMCS rate was even better, only exceeding limits seven times compared to the C-5 and KC-135 that was always in excess of limits (36 times).

There may of course be other factors at work besides the source of depot level repair (public vs. private). One such factor may be the age of the aircraft- the KC-10 is the youngest of the three. But this is only the case when one considers the C-5A and C-5B as the same weapon system (see Table 2 on the next page):

Table 2. Production and Initial Operational Capability (IOC) for the C-5, KC-135, and KC-10

	KC-135[1]	C-5A[2]	C-5B[2]	KC-10[3]
Production Run	1956-1965	1970-1974	1985-1989	1980-1988
IOC	1957	1971	1986	1981

[1] Department of the Air Force, KC-135 Factsheet, 1998.
[2] Hodgkiss, 1998.
[3] Department of the Air Force, KC-10A Factsheet, 1999.

Another GAO report on readiness issues, "Air Transport Capability Falls Short of Requirements" raised similar issues. Among other findings were the following (GAO, 2000):

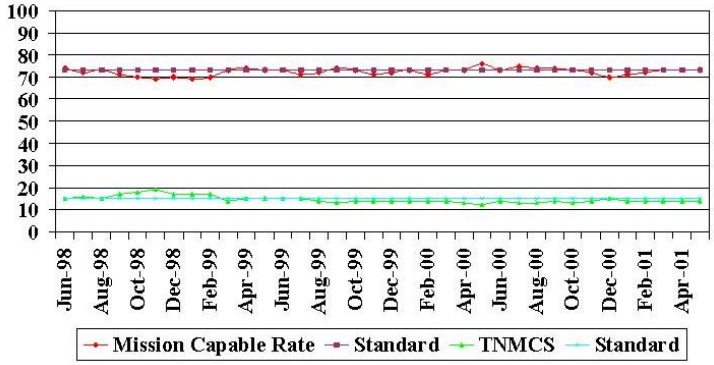
(1) In recent years, the mission capability of these aging aircraft has declined primarily because of the increasing number of aircraft that need depot maintenance.

(2) Air Force data show that C-5 and KC-135 aircraft have suffered lower mission capability due to shortages of spare parts.

Similar findings suggesting the link between spares availability and readiness have been discovered for other weapon systems. Recent reports have highlighted problems specifically with the C-130 weapons systems. Zimmerman's C-130 "Health of the Fleet" PowerPoint brief (Zimmerman, 2001) shows mission capable and TNMCS rates for the entire USAF C-130 fleet for the past 18 months:

Shown below is the slide for the entire C-130 fleet. Although special operations aircraft were not included in these slides, the same basic airframe (C-130) allows some degree of comparison between the conventional aircraft and special operations aircraft. The remaining slides, showing mission capable and TNMCS rates for each operating command, are included at Appendix D. If one looks closely at the slide below, dips in the mission capable rate show a corresponding increase in TNMCS rates. Not surprisingly, this demonstrates that as TNMCS goes up, mission capability typically goes down.

Fig 10. C-130 (ENTIRE FLEET) MC/TNMCS Rates



While these figures visually suggest the relationship between spares levels and weapon system readiness, a more specific investigation is possible. The data was organized in a tabular fashion, indicating the percentages of months out of the total time span that were:

A. Below standard for mission capable (MC) and TNMCS

B. At or above standard for MC and TNMCS

C. At or above standard only for MC rate; and

D. At or above standard only for the TNMCS rate

The goal of building this table was to look for some relationship between TNMCS and MC. The results for the whole fleet in Table 3 were not expected. While it was possible to meet the MC standard without meeting the TNMCS standard, the opposite was not true. It would seem that operating commands have found methods to counter the situation created when NMCS rates are below standards. This may be a useful study and is included in recommendations for further research.

Table 3. Relationship between TNMCS and MC for all C-130s

Neither MC nor TNMCS met standard	19.4%
MC and TNMCS met standard	55.6%
Only MC met standard	25%
Only TNMCS met standard	0%

Table 4 on the next page shows the results from analyzing the Tables in Appendix D for each operating command. Notably, this analysis shows that at least half the time, neither MC nor TNMCS met standards for ACC or AMC.

Table 4. Relationship between TNMCS and MC for all C-130 Operating Commands

	ACC	AMC	AETC	ANG	AFRC	PACAF	USAFE
Neither MC nor TNMCS met standard	50.0%	55.6%	19.4%	27.8%	36.1%	13.9%	25.0%
MC and TNMCS met standard	33.3%	11.1%	72.2%	27.8%	44.4%	61.1%	50.0%
Only MC met standard	16.7%	33.3%	5.6%	44.4%	2.8%	5.6%	8.3%
Only TNMCS met standard	0.0%	0.0%	2.8%	0.0%	16.7%	19.4%	16.7%

The final step in this analysis was to count the 18 months of the 7 commands rates for a total of 252 data points. This method gives equal weight to each customer while disproportionately weighing the impact of each C-130 airframe because the commands possess differing numbers of aircraft

Table 5. Relationship between TNMCS and MC for Operating Commands Combined

Neither MC nor TNMCS met standard	32.5%
MC and TNMCS met standard	42.9%
Only MC met standard	16.7%
Only TNMCS met standard	7.9%

Table 5 should be considered as a different emphasis of the same data presented in Table 3. While Table 3 is an airframe-based (C-130) analysis, Table 5 is a customer-based analysis of how their C-130's are performing. By considering each customer equally in Table 5, the percentage of time that neither MC nor TNMCS rates met standards increases from 19.4 percent to 32.5% and the time that only TNMCS met standards increases from 0 percent to 7.9 percent. While some of this difference is accounted for by a by the decrease in time that only the MC rate met standard, from 25 percent to 16.7 a larger amount is accounted for by the decrease in the time that both rates met standards, from 55.6 percent to 42.9 percent.

The issue of supply availability vs. readiness has been supported with two GAO reports, "Air Transport Capability Falls Short of Requirements" and "Updated Readiness

Status of U.S. Air Transport Capability". The lack of sufficient spares is evidenced by Non-Mission Capable Supply (NMCS) and Cannibalization rates for the C-5, KC-135, and KC-10 weapon systems for Fiscal Years 1997-2000 and by unacceptable (more than 50% of the time for ACC and AMC) Mission Capable and NMCS rates (GAO, 2000), (GAO, 2001).

Studies That Already Looked at 'Private vs. Public' Sourcing

A key issue raised by this research involves the performance of public (depot) vs. private (contractor) performance in providing spares to Air Force operational units. 1Lt Loughran and Mr. John Webb attempted to answer this question from the perspective of "can we determine whether or not outsourcing is a better value than maintaining a capability in-house?" in a 1999 study (Loughran, 1999). They decided to take advantage of the unique situation presented by the outsourcing of depot-level maintenance for the F-117. This was accomplished under a program called Total System Performance Responsibility (TSPR). TSPR transitioned responsibility for the following tasks from the government to the contractor: item management, material management, technical orders, production management, configuration management, data management, test and evaluation management, and safety. The transition of these responsibilities gave total control and responsibility for depot-level maintenance to the contractor (Loughran, 1999).

Their study used archival cost data and mission capability factors, top level management reviews, and a customer satisfaction questionnaire to examine the relative value of outsourcing depot support of the F-117. Their analysis found that technical performance has been equal or better to the previous depot support, and savings of approximately $25

million is projected for the first year. The technical performance results are shown in Table 6.

Table 6. Comparison of Government's Performance (1997&1998) to First Seven Months of the Contractor's Under TSPR

Fiscal Year 1997													
Metric	STD	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
MC %	80	83.3	84.8	87.2	85	81.3	83.6	83.8	86.4	82.6	83.7	83.7	81.4
TNMCS%	7	5.8	6.0	4.7	5	5.3	3.2	1.8	3.1	4.7	5.1	4.4	3.6
Micap Hrs	72				62.2	41.3	54.5	45.8	66.2	72.1	58.0	74.9	75.7
RSP Fill Rate %	96				98.9	99.8	99.8	99.7	99.1	99.4	98.9	99.5	93.6
Depot Del days	1												
Depot Qual - # Disc (major/minor)	4:10												
DR Resp days	5				1	0	0	0	0	0	0	0	0
WST Avail %	97				100	99.4	100	100	100	100	100	100	98.9
Fiscal Year 1998													
Metric	STD	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
MC %	80	76.1	76.2	76.9	75.4	77.1	77.9	82.1	83.3	82.3	78.9	77.9	82.9
TNMCS%	7	4.1	5.1	7.1	6.4	7.9	6.4	6.3	5.5	4.9	5.2	5.5	5.4
Micap Hrs	72	47.1	63.4	75.1	57.8	61.4	59.9	43.3	69.3	148.5	44.7	45.7	43.5
RSP Fill Rate %	96	96.8	100	100	100	100	99	99.3	99.7	99.3	99.6	99.1	98
Depot Del days	1	14	7.5	0	0	0	0	0	0	0	0	0	0
Depot Qual - # Disc (major/minor)	4:10	2.4:1.1	2.6:2.2	2.4:1.0	2.7:2.3	3.6:2.8	2.8:2	1.8:8	2.1:8	1.8:1.0	1.0:1.6	0.6:0.6	1.0:1.0
DR Resp days	5	0	0	0	0	0	0	0	0	0	0	0	0
WST Avail %	97	100	100	100	100	100	100	99.4	100	100	98.9	100	99.3
Fiscal Year 1999													
Metric	STD	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
MC %	80	84.3	82.1	84.9	85.1	82.5	86.7	79.3					
TNMCS%	7	3.1	3.4	1.4	2	1.7	1.7	5.5					
Micap Hrs	72	70.9	28.2	30.2	29.5	31.9	32.2	47.1					
RSP Fill Rate %	96	99	99.2	99.1	99.1	99	98.8	99					
Depot Del days	1	0	0	0	0	0	0	0					
Depot Qual - # Disc (major/minor)	4:10	2.1.:0.8	2.1:0.8	2.1:0.8	2.0:4.0	2.0:4.0	2.0:4.0	3:3					
DR Resp days	5	0	0	0	0	0	0	0					
WST Avail %	97	100	100	100	100	100	100	99.9					

Metric	MC	TNMCS	Micap	RSP fill rate	Depot Del	Depot Qual	DR Resp	WST
STD	80%	7%	72 hrs	96%	1 day	5 maj: 10 min	5 days	97%
Green	≥80%	≤7%	≤72	≥96%	≤1	Maj≤5: Min≤10	≤5	≥97%
Yellow	≥60%<80%	>7%≤11%	>72≤180	≥87%<96%	>1≤2	5<Maj≤8; 10<Min≤16	>5≤10	>95%≤97%
Red	<60%	>11%	>180	<87%	>2	Maj>8: Min>16	≥11	<95%

Loughran and Webb answered the following three specific questions with their analysis:

1. Are the contract performance metrics good indicators of better value? They found the metrics adequate to use as a basis of comparison of performance before and after TSPR. Those metrics were: mission capable rate, MICAP delivery, RSP kit fill rate, depot delivery, depot quality, delinquent deficiency report rate, and weapon system trainer availability rate.

2. Has the decision to outsource the responsibility for the F-117 depot-level maintenance provided a better value to the Air Force? They found that "projected savings for FY99, based on the contractor's estimate to complete, equate to $25.2 million." Looking solely at cost, TSPR is providing a better value. Furthermore, their analysis indicates there is little difference between the level of sustainment support prior to TSPR and the level of sustainment support after award of the contract. As a result, the better value is solely a result of the decreased costs.

3. If outsourcing F-117 depot maintenance is an equal or better value, do we still want to give up the potential core capability? All of the interviewees stated that the government lost very little due to the fact that the contractor has always performed the maintenance on this aircraft. However, the interviewees claim that the Air Force did lose some capability in sustaining engineering and asset management. Although the consensus was that compared to projected savings of $177.6 million, the loss was very small (Loughran, 1999).

Although this research was rather interesting, it's applicability to the issue of alternatives to unscheduled maintenance is indirect. The Loughran study was built to

examine a fait accompli, rather than predict future results. And, although the F-117 can be considered a low-density, high-demand asset like special operations aircraft, the similarities nearly end there. As previously mentioned it has always been contractor maintained and is not as old as those systems fielded by special ops.

Loughran's study was the only source found that specifically addressed the issue of public vs. private aircraft parts sourcing; although this was with respect to changing overall management responsibility for depot support to the F-1117. The measures that Loughran used to measure the two different processes were: mission capable rates, TNMCS hours, Micap hours, readiness spares fill rate, depot delay days, depot quality (in terms of the number of discrepancies found), depot responsiveness, and weapon system trainer availability. There were a number of weaknesses in using this study: a) the evaluation was for a process change that already occurred versus a predictive analysis for future actions; b) the contractor was already performing the depot maintenance; and c) the F-117 is not as old as some of those systems used by special ops. One principal advantage to using this study was that both the F-117 and special operations aircraft are considered low-density high-demand resources. The findings of the study were that the contractor has technically performed equal to or better than the government and savings of approximately $25 million are projected for the first year.

Allocation of Fixed Costs

Several sources noted that as the cost for government depot parts increases, customers are discouraged to use the government depots. If customers are pulled away by less costly parts elsewhere that leaves a smaller inventory of government depot parts to allocate their fixed costs against. The result of this is to increase the percentage of

total cost that the fixed costs represent and to increase the total cost to the customer. This results in the unit cost of the remaining parts to increase, creating a "death spiral" of increasing costs for the remaining depot customers. By optimizing a subsystem like this, we can paint ourselves into a corner. Customers that are unable to find the money to pay for their parts will decay into a state where they are unable to accomplish their wartime mission. This could set off a chain reaction of increasing costs and decreasing service could impact everyone in the Air Force.

This chapter presented the findings (identified issues) of the expert panel, detailed the results of secondary source content analysis in Table 1 and Appendix B, and presented excerpts from the secondary sources that contributed to the developing main theme that aircraft spare and repair parts have been reduced below levels required to sustain current infrastructure and opstempo. Evidence of this proposition was presented in the form of NMCS and Cannibalization rates for the C-5, KC-135, and KC-10; and by C-130 MC and TNMCS rates. A review of one source that looked at public vs. private parts sourcing was presented and their conclusions reviewed. It concluded with a short review on the allocation of fixed costs and the implications towards long term sustainability for government depots.

Identified Weakness - Presentation of Sources Suggesting Applicability of SOG Experience to Reparables

Unfortunately, no research was found that supports the proposition that improvements in the unscheduled maintenance process currently applied to expendables can be transplanted into the reparable unscheduled maintenance process. Because this is an important question and the author was unable to address it at this time, it is

recommended for further research. A review of the findings in this paper and conclusion follows in Chapter V.

V. Findings and Conclusions

Overview

The purpose of this chapter is to present the findings, recommendations, and conclusions based upon the research conducted. First, the answers to the investigative questions are summarized from Chapter IV, and then some general comments and recommendations are made.

This paper sought to answer the question, what are the issues related to alternatives in the unscheduled maintenance of Air Force aircraft? Specifically, these procedures are related to those used by the 352d Special Operations Group in sourcing expendable aircraft parts for which estimated delivery dates are unacceptable. The answers to this question are found in the next section, Findings. The research for this paper was conducted with the preconceived notion that there would be just two dimensions to the issues, either cost or readiness. What was eventually determined was that a more useful model will have three axes, cost, readiness, and political equity. A definition for political equity is included below along with three citations that provide a clear insight to this scenario.

Conclusions and recommendations are included last. The most significant conclusion is the proposal that parts inventories have been reduced below the level required to sustain current infrastructure and opstempo. The recommendations that follow are primarily recommendations for further research that will either verify or negate this proposal.

Findings

It was originally hoped that this paper would be able to present a cost benefit analysis of the SOG's method for obtaining expendable aircraft parts. While we were unable to specifically draw conclusions as to the cost-benefit of the outsourcing option, a more significant general finding was discovered. It is now proposed that national defense (or the effectiveness of the sourcing decision) can't be readily expressed on two-dimensions, cost and readiness. There are numerous other issues that find their way into the equation, and if one hopes to change the processes that have become entrenched in the organizational structure of the Air Force, one must consider their impact.

During this research both the expert panel and the content analysis of the literature identified the following issues:

- Depot Maintenance
    - -- Increasing amount of depot maintenance
    - -- Conflicting / Changing guidance and policies on depot content (60/40 v 50/50)
    - -- Disparity between DOD and Depot budgets
    - -- 50/50 rule as a "stumbling block"
    - -- One expert opinion that advancing technology has made it so that any repair can be done at the unit with no pipeline
    - -- AFSOC-centric Best Value Analysis (BVA) for the CV-22 – contractor and program manager at one location
    - -- Better customer focus of private industry v government depots

- Costs
    - -- Increasing depot costs with aircraft age
    - -- Increasing depot costs with increased aircraft complexity
    - -- Airframe availability and cost reduction

- Readiness
    - -- Spare and repair parts shortages
    - -- Proof that the SOG's process for acquiring expendables can be implemented in the conventional Air Force
    - -- Airframe availability and cost reduction
    - -- Production planning and execution
    - -- Resource synchronization

- Privatization / Outsourcing / Contract Logistics
    -- Conflicting / Changing guidance and policies on depot content (60/40 v 50/50)
    -- 50/50 rule as a "stumbling block"
    -- AFSOC-centric Best Value Analysis (BVA) for the CV-22 – contractor and program manager at one location

- Logistics Review / Transformation
    -- One expert opinion that advancing technology has made it so that any repair can be done at the unit with no pipeline

- Lean Logistics / Two-Level Maintenance
    -- Significant relationship between parts inventory levels and NMCS rates
    -- One example of increased costs for 2LM (TF39 engine program) that had Air Force wide implications

This paper attempted to address as many of these issues as practical, but even after trying to consolidate them one ends up with different although related sub-issues. The author recognized the difficulties in trying to relate these issues using the two dimensions of Cost and Readiness, and now attempts to provide a more useful model.

From a managerial standpoint, it would be advantageous if we could evaluate different decisions affecting the logistics system in terms of how much they contribute to readiness and at what cost. But at this point, there is s lack of agreement as to how to calculate and evaluate the efficacy of different proposals. GAO will print one conclusion, the NDIA a second; the depot caucus provides a third, and DOD a fourth. Sometimes they agree in part, but mainly they don't. How can this disagreement be resolved?

This paper asserts that programs and changes to policy/procedure can be measured on three axes, not just two. The existence of this "third axis" is proposed to help explain the disagreement in evaluation of value between logistics decisions. There are of course, the two axes first mentioned, cost and readiness. It is proposed that the

missing dimension could explain the disagreement between the numbers and outcomes. This third dimension is termed by the researcher as " political equity."

As defined by the author, 'political equity' is the value associated with specific actions, practices, or policies involved with the act of government.

Three references suggested the presence and influence of this third dimension. The first comes from the 1996 report of the California Chief Executive Officers' Defense Privatization Task Force (California Chief Executive Officers' Defense Privatization Task Force, 1996):

> The mantra of the defenders of the depot status quo has always been "unacceptable risk to readiness." Traditionally, the Services have fought to maintain depot capability to support their "core" requirements. There are two elements to determining core requirements: defining the level of need, and defining the nature of need.
>
> Efforts to justify the proper level of need have been based on both a build-down from a ceiling and a build-up from a floor. In the first, core requirements have been derived from legislation to defend maintaining certain organic requirements within DOD. In others, methods have been used to grow the core workload from a zero-based position. The primary vehicle of the legislatively-derived method is the previously discussed Title 10, USC, Section 2466, "Limitations on the Performance of Depot Level Maintenance of Material." It has been used to define core requirements as 60 percent of DOD depot expenditures. Where DOD has allowed the requirements to be generated from the bottom up, it has not set a standard DOD definition of core. Each Service has been allowed to determine its own formula, and therefore its own definition of "core" requirements.
>
> The DSB acknowledged the wisdom of retaining some level of core capability within DOD, but argued it should be based on skills and facility needs, rather than work on individual weapon systems. The use of the latter method supports duplications among the Services (for example; fixed wing aircraft for the Navy and the Air Force), and does not represent the correct level or nature of a DOD core requirement. In some cases, this method allowed service requirements to be defined as the bulk of their capability. In 1994, General Yates, then Commander of Air Force Materiel Command, argued for 73 percent of Air Force depot capacity to be designated as core. The DSB report noted that in May 1995, DOD was calculating its core requirements at between 40 and 50 percent of its depot capacity. However, the CORM criticized the service methodologies for

> setting core requirements above the needs of the national security strategy. Further, the CORM argued that private contractors could meet all the requirements of DOD, including surge capacity.
>
> The second part of the core issue is the nature of the requirement. What, specifically, is too important to be outsourced? The answer is at the heart of the risk-to-readiness concern. The Services have historically retained "mission-essential operations" based on risk management and lack of private sector capability arguments. For the Air Force, these have included the bulk of airframe and engine maintenance work. Today, however, industry currently does significant amounts of each and could certainly carry the DOD workload. Also, private contractors almost always provide the initial depot-level support for new weapon systems. Moreover, it seems reasonable to assert that if a manufacturer can build an item, it can perform maintenance on it. The CORM agreed, and recommended DOD move to a depot maintenance system relying on the private sector. As the manufacturers referenced, we endorse this recommendation.

The second influential source lending credence to the possibility of the existence of this third dimension is Lt Col Jeff Brown's paper for the National Defense University, Depot Closings and the Destruction of Western Civilization (Brown, 1998):

> The inevitable criticism and expense of laying off so many employees induced the services to leave depots largely untouched in the first three rounds of [base] closings.
>
> However, by the fourth round, scheduled to begin in 1995, the Air Force, in particular, was expected to nominate at least one depot, based on preliminary data that the five major Air Force depots were collectively operating at 48% capacity. It came as a great surprise, therefore, when no Air Force depots were on the list the Department of Defense submitted to the Commission on February 28, 1995. The Air Force claimed the depots were necessary for readiness reasons and that it would cost less to downsize all the depots than it would to consolidate five into three.
>
> Few in Congress or on the Base Closing Commission accepted the Air Force's explanation. Representative Don Nickles R-OK, noted "What's California? Ten percent of the electoral votes. It makes one wonder." Other congressmen, including House Majority Leader Dick Armey of Texas were less subtle, claiming depots were "improperly spared closure for purely partisan reasons." Whether or not the depots were left off the list for political reasons or for sound economic reasons, the perception was for the first time partisan politics had been injected into the process – and the perception was all that mattered.

> …at least one member of the commission staff was convinced the Air Force really wanted to include the depots, but had been overruled by a Secretary of Defense to avoid antagonizing the electoral vote-rich states of California and Texas.
>
> Amid these accusations of political tampering, the commission elected to put Kelly and McClellan back on the table.

There is a third source suggesting the extent that political equity may actually contribute in shaping DOD and national policy decisions. It is an article from James Kitfield titled "Off Base" published in the GovExec.com magazine (Kitfield, 1998):

> While [the] Clinton administration official reluctantly agreed to close the McClellan center and realign the Kelly base, they balked at the prospect of abolishing 22,000 high-paying jobs and alienating voters in two states viewed as key battlegrounds in the 1996 elections. Instead, the White House proposed transferring the facilities and much of the depot work to private industry.
>
> That plan has prompted an acrimonious tug of war in Washington between the Clinton administration and the powerful Depot Caucus on Capitol Hill, whose 50-plus members, all with depots in their districts, stood to gain from the transfer of jobs to other DOD facilities.
>
> "What was originally perceived by the workforce as a plan looking out for their best interest has now been turned into a war of attrition between Congress and the administration, and the workers at McClellan feel caught in the middle of the battlefield with no weapons," says Maj Gen Eugene Tattini, the base's commander. Already the Air Force has had to amend its plans for the McClellan workforce three times, he says, losing credibility and causing added frustration for workers each time.
>
> Ironically, even the local community that was the intended beneficiary of privatization-in-place is now feeling more than a little bent out of shape as a result of the political braw thousands of miles away in Washington.
>
> … "Three years later, however, the uncertainties associated with this constantly evolving plan have greatly added to the complexity of our job in terms of base reuse, and they are causing high anxiety in our local workforce."

This paper asserts that programs and changes to policy/procedure can be measured on three axes: cost, readiness, and political equity. In this circumstance, political equity has been defined as the value associated with specific action, practices, or policies involved with the act of government. The presence of this third axis helps explain disagreements in evaluations of value between logistics decisions. Offered as proof of the utility of this model are the preceding citations regarding the events surrounding the BRAC and the government depots at San Antonio and Sacramento.

Congress created the BRAC because the recognized the political impossibility of recommending specific bases for closure. So they created this commission that was meant to be free of political influence. One unforeseen result of this environment was the creation of the 60/40 rule that provided the necessary justification to keep depots open despite 40 to 50 percent excess capacity. By the fourth round of base closures, it was widely expected that the DOD would recommend consolidating the Air Force's 5 depots into just 3. When DOD did not make that recommendation it was attributed to election year politics. The commission sought to fix these perceived wrongs by putting Kelly and McClellan Air Force Bases back on the base closure table. In a final coup, the Clinton administration supposedly seeking the significant electoral votes of Texas and California saved the bases from closure and instead proposed privatizing the functions in place. Finally, it is suggested that even three years later the communities surrounding those two bases are still suffering from the uncertainties surrounding base reuse and the lack of single clear direction. Future studies to investigate the interaction between political equity and the issues of cost and readiness could prove useful in correctly assessing more appropriate national defense structure decisions.

Conclusions and Recommendations

This paper has shown that while the relationship between spares levels and readiness is fairly direct, the relationship between cost and readiness is not. It has been proposed to add a third dimension, political equity, to cost and readiness as three measures in analyzing maintenance processes. Further Research into the issues surrounding the cost-readiness tradeoff is recommended.

Great ideas are worth repeating, "It should never be just about money. If we ever make the cost more important than readiness then we have lost sight of our mission and the relevance of a separate service dedicated to airpower."

APPENDIX A: Expert Panel Biographies

Colonel Kent Mueller

Colonel Kent Mueller is the Director of Logistics, Air Force Special Operations Command, Hurlburt Field, Florida. He has worldwide responsibility for the readiness of over 100 specially equipped SOF fixed and rotary wing aircraft, and over 3,700 personnel. He directs contracting, transportation, and supply readiness for training, exercises, and contingencies, contributing forces to USSOCOM, the theater CINCs and other Air Force missions. Before becoming the AFSOC LG, Colonel Mueller commanded the 16th Logistics Group, 16th Special Operations Wing at Hurlburt Field. Colonel Mueller led 3,400 military and civilian personnel in ten squadrons. Prior to group command, Colonel Mueller was the Chief of C-130 Production, Warner Robins Air Logistics Center, Robins Air Force Base, Georgia. He led a workforce of over 500, performing depot maintenance and modifications on eleven C-130 variants, in an annual program of over $50M with facilities, and equipment valued at $100M. At WR/ALC he also served in the SOF System Program Office as Air Force Single Manager and product team leader for MH-53J/M PAVE LOW helicopter.

Col Mueller is the recipient of numerous awards that have resulted from his 'outside the box' thinking. Among them include: the 2001 Air Force XP Productivity Excellence Award, 2001 American Society of Military Comptrollers Meritorious Performance Award, 2000 Secretary of Defense Maintenance Award, 1999 Clement C. McMullan Daedalian Trophy, 1999 Air Force Rotary Wing Maintenance Effectiveness Award, 1999 USCINCSOC Team Award, 1999 CSAF Team Excellence Award Finalist, 1999 General Bernard A. Schriever Award, DAC SPO of the Year, 1988 Best in Air

Force Organizational Maintenance Squadron, 1986 Air Force Company Grade Maintenance Officer of the Year, 1984 HQ 21st Air Force Junior Officer of the Year, 1984 Air Force Association, McGuire Chapter, Junior Officer of the Year, and the 1982 Airlift Association Young Leadership Award

Col Mueller's specialized training includes the Aircraft Mishap Investigation Course, the Basic Airborne Course, and the Jumpmaster Course. He attended Professional Military Education at the Squadron Officer School, (residence), United States Marine Corps Command and Staff (correspondence), Air Command and Staff College (residence), the Armed Forces Staff College (JPME II residence), Air War College (seminar), and the Defense Systems Management College (residence). He also holds a Bachelor of Journalism Degree, and a Masters Degree in Industrial Management.

Colonel John Easley

Colonel John L. Easley is the Director of Logistics, Center for Acquisition and Logistics, United States Special Operations Command, MacDill Air Force Base, Florida. Prior to this assignment he was the 314th Logistics Group Commander, Little Rock AFB, Arkansas. He came to Arkansas from Hurlburt Field, Florida where he was the Deputy Commander of the 16th Logistics Group. Prior to that he was the Commander of the 352d Maintenance Squadron, RAF Mildenhall, United Kingdom. His career also includes four years of experience as the Deputy Chief, Planning and Engineering Branch and Deputy Chief, Production Branch in the Aircraft Division and Deputy Chief, Plant Management Division of Warner Robins Airlift Center, Robins Air Force Base, Georgia.

Colonel Easley is a career aircraft maintenance officer who has held a variety of positions in field and staff units, including command of the 352nd Maintenance Squadron, winner of the USAF Maintenance Effectiveness Award in both 1994 and 1996. He participated in the earthquake relief airlift to Van, Turkey, in 1976, and in two AC-130H deployments for Operation CONTINUE HOPE conducting peacekeeping operations in Somalia. He also deployed numerous times for Operations PROVIDE PROMISE, DECISIVE ENDEAVOR, and JOINT GUARD supporting peacekeeping operations in Bosnia / Herzegovina.

Colonel Easley's professional military education includes Squadron Officer School (residence), Marine Corps Command and Staff College, (correspondence), Air Command and Staff College (correspondence), and the Air War College (correspondence). His civilian credentials include a Bachelor of Arts degree in history from Indiana University in 1975 and a Master of Arts degree in government and human relations from Webster College in 1982.

Lieutenant Colonel Paul Webb

Lieutenant Colonel Paul A. Webb is the commander, 352d Maintenance Squadron, Royal Air Force Mildenhall, United Kingdom. He is responsible for the day-to-day maintenance and repair of 18 highly modified special operations fixed and rotary wing aircraft. As the commander he leads over 400 personnel, RAF Mildenhall's largest squadron, in meeting this demanding mission. Previous assignments included being the commander of the 463rd Logistics Support Squadron, 463rd Airlift Group and the Maintenance Supervisor of the 314th Maintenance Squadron, 314th Airlift Wing at Little Rock AFB, Arkansas. At Osan Air Base, Republic of Korea, he was the Officer-in-

Charge of Equipment Maintenance for the 31st Special Operations Squadron. Prior to that he was Chief, Maintenance Management Procedures, at Headquarters, Air Mobility Command, Scott AFB, Illinois. Lt Col Webb's Air Force career began in 1974 when, after graduating from high school, he enlisted in the Air Force and entered active duty. After serving for 11 years as an aircraft loadmaster, he was commissioned through Officer Training School, Lackland AFB, Texas, in April 1985.

Lt Col Webb's professional military education includes Squadron Officer School (residence), and the Air Command and Staff College (seminar). He holds an Associates Degree in Transportation Management, a Bachelor of Science Degree in Industrial Technology, and a Master of Science Degree in Operations Management.

Mr. Franklin Spinney

Although the researcher was unable to contact Mr. Spinney directly, a number of his articles were used in forming opinions and several provided significant information to the writing of this paper, for that reason his credentials are included here. Franklin C. Spinney has over twenty-five years experience as a research engineer and program planner in the U.S. Air Force and the Office of the Secretary of Defense. He is author of Defense Facts of Life: The Plans/Reality Mismatch (1985), and Defense Power Games (1990), as well as articles in the Washington Post, the Wall Street Journal, and The Proceedings of the Naval Institute. Spinney's work, while controversial, has received international recognition for its quality and comprehensiveness. He has appeared before Congress as an expert witness on many occasions. He holds a B.S. in Mechanical Engineering and an M.B.A.

APPENDIX B: Secondary Source Content Analysis

The secondary sources covered the following 10 topics as shown in table 1 below:

Table 7. Frequency of Topic Covered by Each Secondary Source

Author / Source	2 LM	Contract Logistics	Costs	Depot Maintenance	Lean Logistics	Log Review / Transformation	Outsourcing	Privatization	Readiness	Other
352 SOG Mission Brief										1
Ames	1									
Anderson				1						
Annis		1	1							
Associated Press									1	
Barlow	1			1	1					1
Bachman				1						
Berman									1	
Bollinger					1					
Bosker						1				
Bowling			1	1			1			
Braman			1	1				1		
Brennan										1
Brauer				1						
Butler		1	1	1			1	1		
Carlson					1				1	
Carter										1
Cate			1	1				1		
Center for Strategic and Budgetary Assessment			1	1					1	
Cerniglia										1
Chandran			1						1	
Cohen			1	1	1	1			1	
Conetta									1	
Daniels		1	1	1						
Davis, Paul			1			1			1	
Davis, William						1				
Deal									1	1
DOD, JP 1-02										1
DODD, 4151.18										1
Dept of the Air Force, Budget Guidance & Procedures			1							
DMAPS				1		1				

Author / Source	2 LM	Contract Logistics	Costs	Depot Maintenance	Lean Logistics	Log Review / Transformation	Outsourcing	Privatization	Readiness	Other
Depot Maintenance Management				1						
KC-10A Extender Fact Sheet										1
KC-135 Stratotanker Fact Sheet										1
Maintenance Management of Aircraft										1
MC-130E/H Combat Talon I/II Fact Sheet										1
Special Operations										1
USAF Supply Manual										1
Deputy Under Secretary of Defense			1		1	1	1	1	1	
Devers				1					1	
Dooley										1
Dredla									1	
Dynamic Resarch Corporation			1	1			1	1		
Eltringham						1	1	1	1	
Embry		1	1	1			1	1	1	
Eriksen	1			1	1					
Federal Aviation Administration										1
Forsythe		1	1	1						
Frost and Sullivan, Press Release		1		1			1	1		1
Executive Summary		1		1						1
Gaddis			1		1					
Graul				1		1				
Gruber			1	1					1	
Harris					1	1	1	1	1	
Hatcher		1	1	1	1	1	1	1	1	
Headquarters United States Air Force			1	1	1	1	1	1	1	
Hodgkiss										1
Holt		1	1							
Hopp						1				
Hutson	1			1	1				1	
Inspector General, Dept of Defense			1	1						
Joint Chiefs of Staff, Joint Vision 2010				1	1	1	1	1	1	
J4, Projects			1	1	1	1	1	1	1	
Judge					1	1			1	
Kalish			1	1						
Kennedy			1	1		1	1	1	1	
Kearsley Airways Group		1								

Author / Source	2 LM	Contract Logistics	Costs	Depot Maintenance	Lean Logistics	Log Review / Transformation	Outsourcing	Privatization	Readiness	Other
Kratz				1		1			1	
Labosky				1	1				1	
Langley										1
Larvick	1		1	1	1	1			1	
Lipscomb	1		1	1						
Lorraine					1	1			1	
Loughran			1	1		1	1		1	
Marshall Group		1								
Mason		1		1			1	1	1	
Matthews										1
McBride			1	1	1				1	
Mehuron										1
Moore										1
Morrill						1				
Office of the Sec of Def, Air Force Depot Maint Strategy				1			1	1	1	
Report to Congress				1						
O'Malley			1	1					1	
Pagonis										1
Palmer			1						1	
Patterson					1	1				
Pyles			1	1					1	
Rieckhoff		1	1	1			1	1	1	
Rodrigues			1	1						
Rome Laboratory				1					1	
Scalzo			1	1					1	
Schlesinger			1			1				1
Shelton										1
Simard			1	1					1	
Simon			1	1						
Spinney, Front Loading the C-130J			1							
Defense Death Spiral			1	1					1	
Spaulding			1	1				1		
Taylor			1		1					
The Aviation Zone										1
The Road Ahead			1	1		1	1	1	1	
Appedix A			1	1		1	1	1	1	

Author / Source	2 LM	Contract Logistics	Costs	Depot Maintenance	Lean Logistics	Log Review / Transformation	Outsourcing	Privatization	Readiness	Other
Tozer			1						1	
Trask										1
Tyson			1						1	
United States GAO, Air Force Aircraft			1						1	1
Air Force Depot Maintenance			1						1	1
Air Force Privatization in Place			1	1				1		
Contract Management		1	1	1						
Defense Depot Maintenance: CORM…				1				1		
Defense Depot Maintenance: DOD's Policy….				1			1	1		
Defense Depot Maintenance: DOD Shifting….			1	1			1	1		
Depot Maintenance: Some Funds….			1	1						
Industrial Base: Assessing the Risks…..			1	1					1	
Military Readiness: Air Transport Capability….			1						1	
Military Readiness: Updated Readiness Status….			1						1	
Navy Maintenance: Public / Private Competition….		1	1				1	1		
Overseas Presence: More Data….			1							1
Public-Private Competitions:		1	1				1	1		
Special Operations Forces….			1							
United States Special Operations Command			1	1						
Wagner									1	
Walsh									1	
Warren		1	1	1						
Weigand			1	1						
Wuchenich		1		1					1	
Zimmerman									1	
TOTAL OCCURENCES	6	17	61	62	20	25	23	26	52	30

APPENDIX C: NMCS and Cannibalization Rates (KC-135 and KC-10)

Fig 11. C-5 NMCS Rate

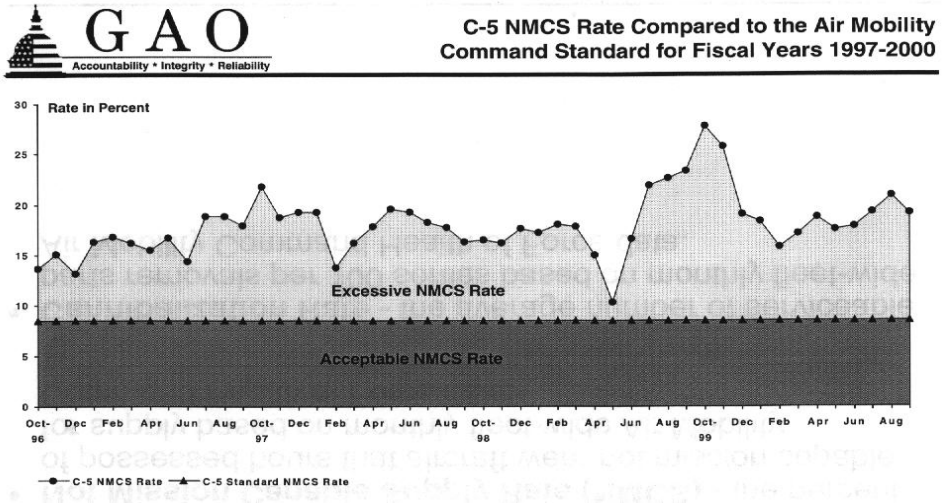


Fig 12. C-5 Cannibalization Rate

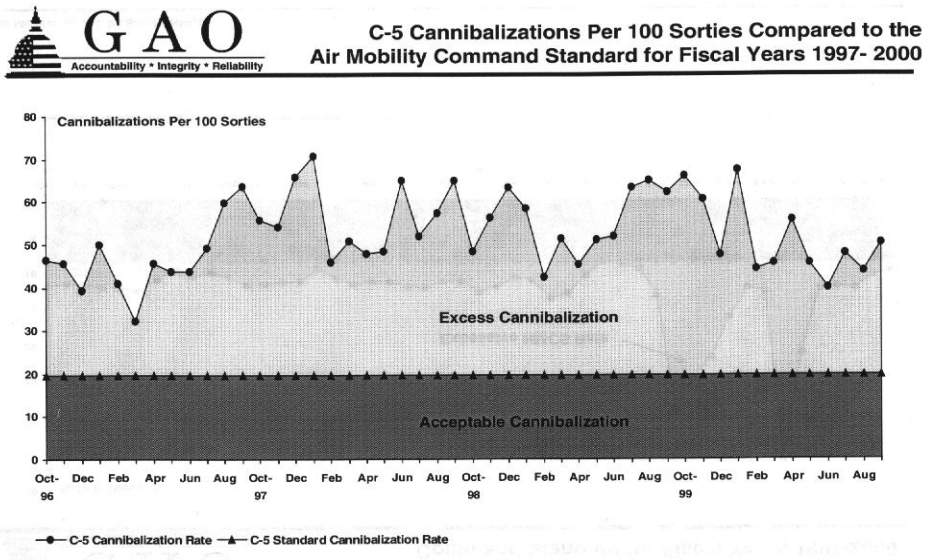


Fig 13. KC-10 NMCS Rate

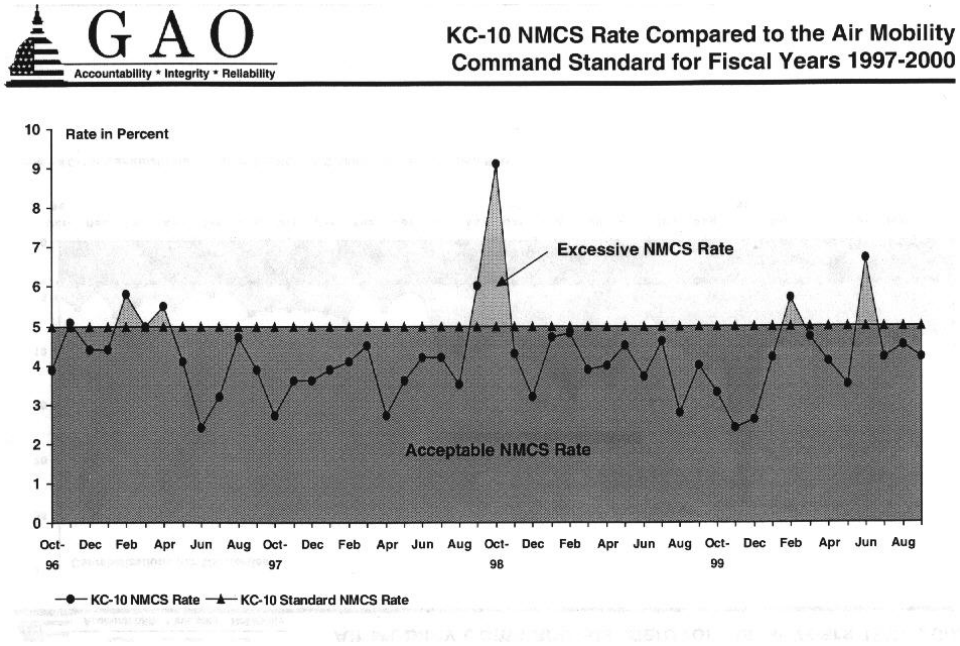
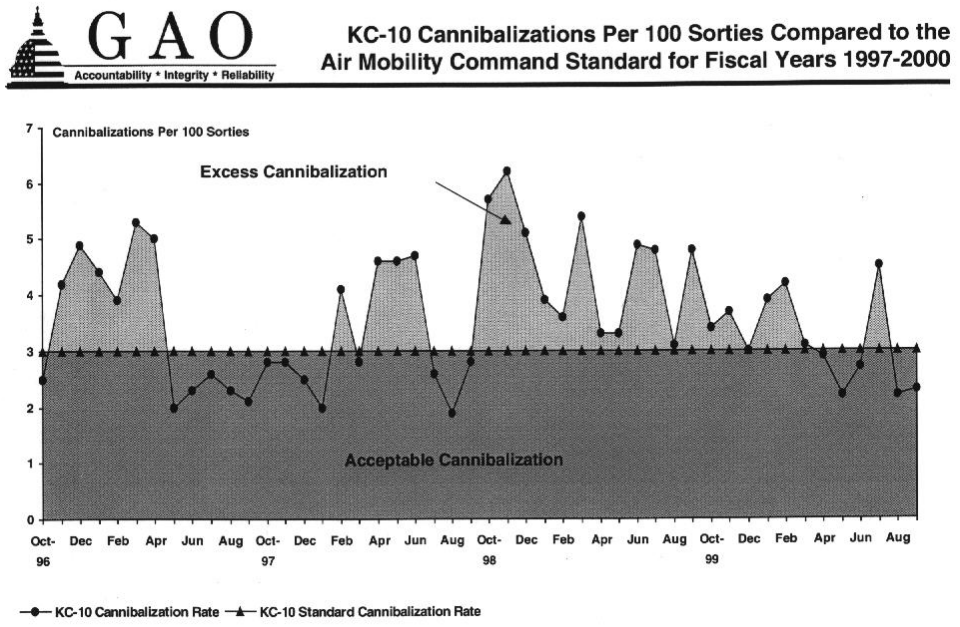


Fig 14. KC-10 Cannibalization Rate



APPENDIX D: C-130 MC and TNMCS Rates

Fig 15. ACC C-130 MC/TNMCS Rates

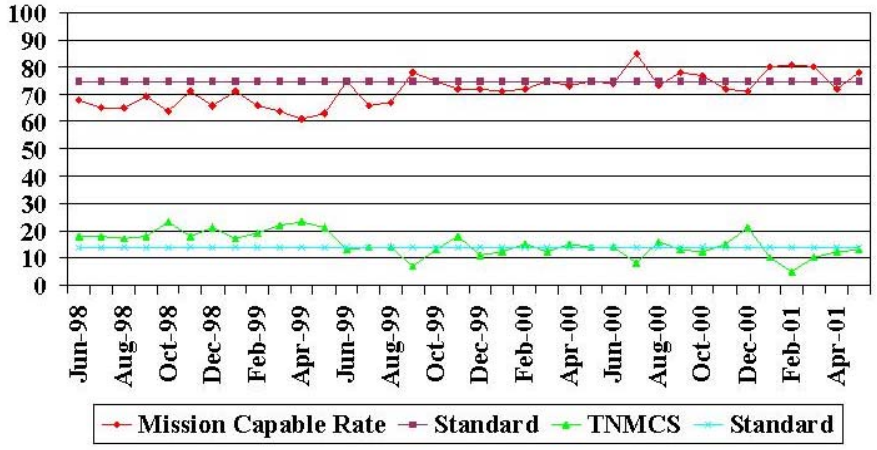


Fig 16. AMC C-130 MC/TNMCS Rates

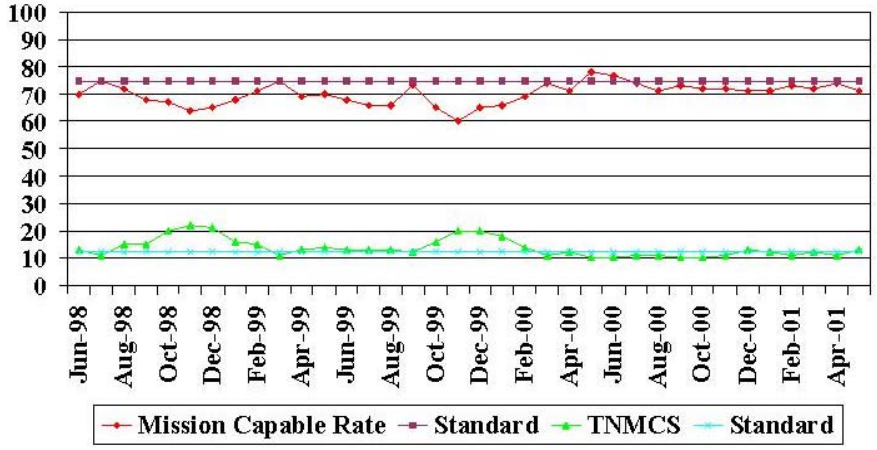


Fig 17. AETC C-130 MC/TNMCS Rates

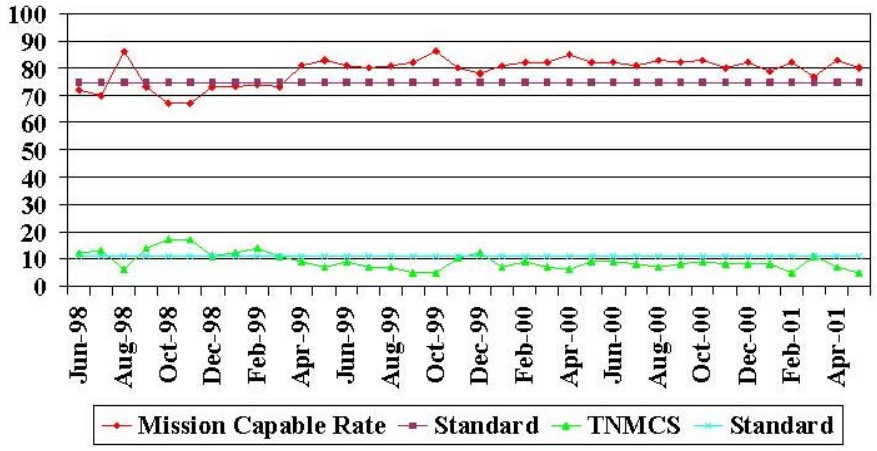


Fig 18. ANG C-130 MC/TNMCS Rates

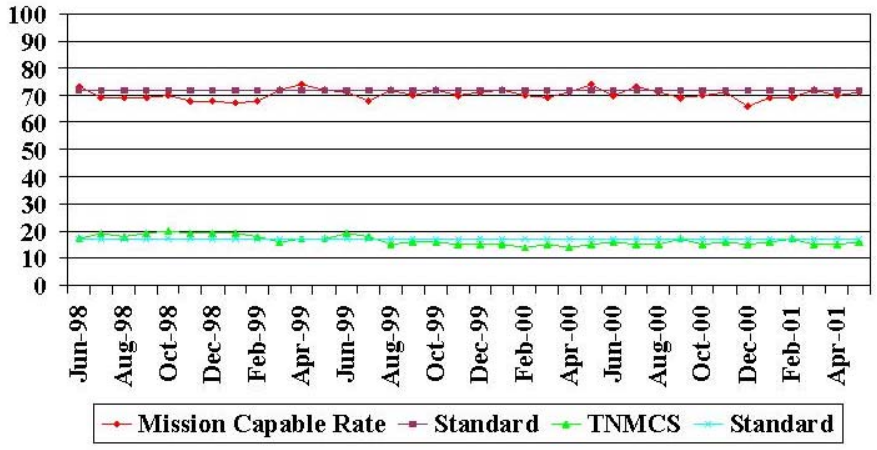


Fig 19. AFRC C-130 MC/TNMCS Rates

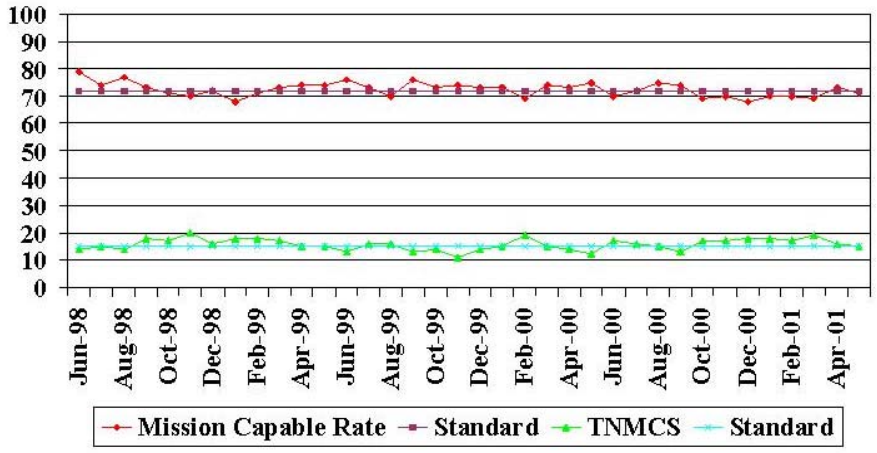


Fig 20. PACAF C-130 MC/TNMCS Rates

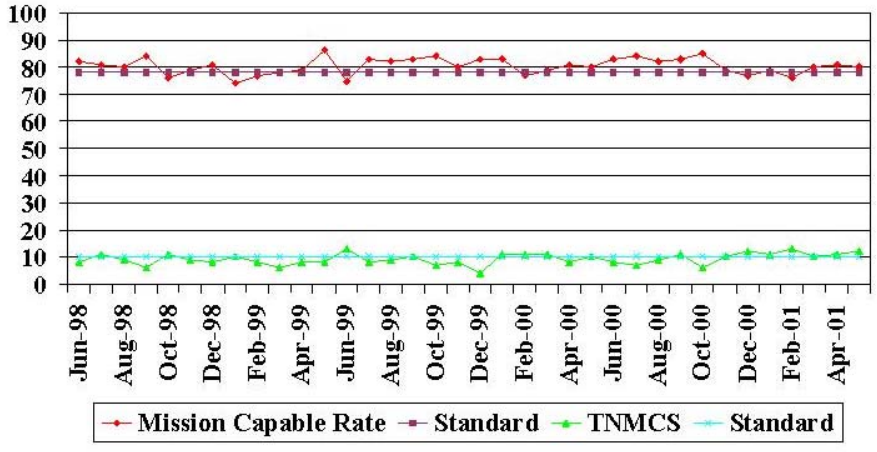
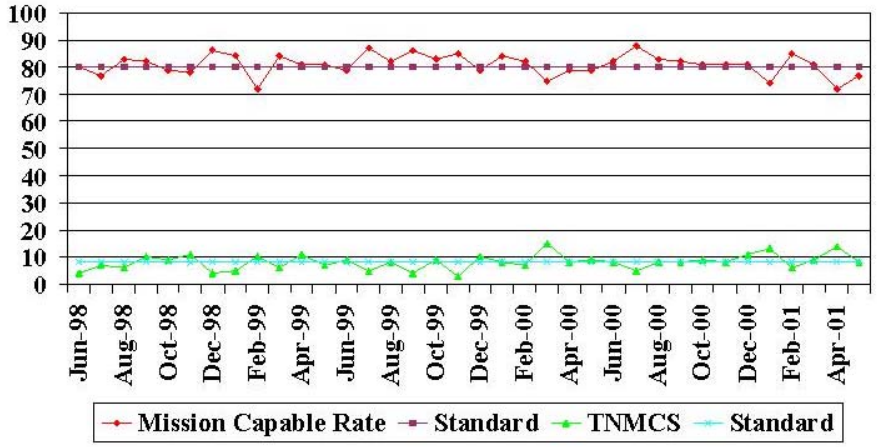


Fig 21. USAFE C-130 MC/TNMCS Rates



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Vita

Major Daniel M. Wuchenich was born in Livermore, California. He graduated from Upper St Clair High School in Pittsburgh, Pennsylvania in June 1984 and entered the United States Air Force Academy graduating with a Bachelor of Science degree in Engineering Science in June 1988.

Following technical training at Chanute AFB, Illinois, Lt Wuchenich was assigned to Loring AFB, Maine in November 1989. Serving in numerous capacities with the 42d Bomb Wing, this assignment culminated with his job as the 42d Air Refueling Squadron's maintenance operations officer. In 1993 his maintenance team achieved a remarkable 27 "black letter initial" no discrepancies prior to flight exceptional releases.

Attending Squadron Officer School enroute, Capt Wuchenich was reassigned to the 314th Airlift Wing at Little Rock AFB, Arkansas in February 1994. Sortie Generation Flight Commander for the 50th Airlift Squadron, he was instrumental in transitioning the squadron from the C-130E to the C-130H3. He deployed twice with his squadron prior to being selected for career broadening into base level contracting in 1995. Extensive training and experience resulted in his Level I Certification. In 1996 he earned a Master of Science Degree in Operational Management through the University of Arkansas.

In August 1997 he was reassigned to the 352d Maintenance Squadron, RAF Mildenhall, United Kingdom. During Operation Allied Force, as a result of the untimely retirement of his squadron commander, Major select Wuchenich became the acting commander for the 352d Maintenance Squadron, RAF Mildenhall's largest squadron. In May 2000, he entered the Advanced Studies of Air Mobility, at the Air Mobility Warfare Center. Upon graduation, he will be assigned to NATO/AIRSOUTH at Naples, Italy.

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ABSTRACT (*Maximum 200 Words)*

The purpose of this paper is to identify issues related to alternative procedures in the unscheduled maintenance of Air Force aircraft. Specifically, the procedures investigated are those used by the 352d Special Operations Group (SOG) in sourcing expendable aircraft parts for which estimated delivery dates are unacceptable. The SOG's experience has been that direct sourcing from private contractors has resulted in superior delivery response times. Further, they believe that their experience with expendables could be extended into the management of reparables. Since adopting these procedures formally would require changes in Air Force policies, these procedures need to be evaluated from a broader level. The intent of this paper is to identify the issues related to such an analysis. Because the subject of this research topic has not yet been thoroughly or formally investigated, the sources of information were primarily expert opinions, combined with an analysis of related theses, reports, and journal articles. The major finding of this research has been that while the relationship between spares levels and readiness is fairly direct, the relationship between cost and readiness is not. A third dimension of the problem is proposed. Further research into the issues surrounding the cost-readiness tradeoff is recommended.

14. SUBJECT TERMS
Unscheduled Maintenance, Special Operations, Aircraft Parts, Contractors, Source of Repair, Source of Supply, Depot Maintenance, Costs, Readiness, Privatization, Outsourcing, Contract Logistics, Logistics Review, Logistics Transformation, Lean Logistics, Two-Level Maintenance, 2LM

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