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Performance Based Logistics (PBL) for the FA-18/S-3/P-3/C-2 auxiliary power unit (APU) at Honeywell: an applied analysis

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MBA PROFESSIONAL REPORT

Performance Based Logistics (PBL) for the FA-18/S-3/P-3/C-2 Auxiliary Power Unit (APU) at Honeywell; An Applied Analysis

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December 2005

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The purpose of this MBA project is to evaluate and assess the metrics, incentives and other terms and conditions of the Performance Based Logistics (PBL) contract between Naval Aviation Inventory Control Point (NAVICP) and Honeywell in support of FA-18/S-3/P-3/C-2 Auxiliary Power Unit (APU) to determine if the contractual terms and conditions established are effective in facilitating and encouraging the full potential of PBL savings and improved performance. PBL is an acquisition reform initiative intended to improve weapon system logistics with the goals of: 1) compressing the supply chain, 2) eliminating non-value added steps, 3) reducing total ownership costs, 4) improving weapon system readiness and reliability, and 5) reducing logistics footprint. PBL entails buying measurable outcomes with metrics based on war fighter stated performance requirements. The war-fighter requirements should be linked to metrics and metrics should be linked to contract incentives. An additional element of PBL is gain sharing, which ensures the contractor’s profit and the government’s increased performance at a reduced cost. Based on the elements of PBL, the objectives of this project include; 1) comparing the actions/activities/accomplishments of the contract to the goals of PBL, 2) measure and appraise the attainment of those goals 3) provide information about the major factors causing the observed effects on the above, and 4) identify and analyze the metrics and incentives for their effectiveness in achieving the desired outcomes.

In meeting the objectives of this report, our findings indicate that non-value added steps were eliminated, and there were potential reductions in the logistics footprint. On the other hand, the supply chain was not compressed; aircraft maintenance costs did not decrease; and more importantly, the APU reliability for the FA-18, S-3, and C-2 did not improve. For the P-3, reliability improved by 7% to 19%, but not 300% per the contract guarantee. Our research also determined that the reliability metric was inappropriate for measuring and tracking APU reliability improvements. Additionally, disincentives were provided for not meeting contract requirements with the only contract incentive being the award term contract arrangement. Our report provides recommendations specific to the APU TLS contract and other recommendations for other PBL applications. These recommendations include an alternative contract pricing and gain sharing methods and appropriate metrics and incentives that reflect the true definition of PBL.

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PERFORMANCE BASED LOGISTICS (PBL) FOR THE FA-18/S-3/P-3/C-2 AUXILIARY POWER UNIT (APU) AT HONEYWELL; AN APPLIED ANALYSIS

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ABSTRACT

The purpose of this MBA project is to evaluate and assess the metrics, incentives and other terms and conditions of the Performance Based Logistics (PBL) contract between Naval Aviation Inventory Control Point (NAVICP) and Honeywell in support of FA-18/S-3/P-3/C-2 Auxiliary Power Unit (APU) to determine if the contractual terms and conditions established are effective in facilitating and encouraging the full potential of PBL savings and improved performance. PBL is an acquisition reform initiative intended to improve weapon system logistics with the goals of: 1) compressing the supply chain, 2) eliminating non-value added steps, 3) reducing total ownership costs, 4) improving weapon system readiness and reliability, and 5) reducing logistics footprint. PBL entails buying measurable outcomes with metrics based on war fighter stated performance requirements. The war-fighter requirements should be linked to metrics and metrics should be linked to contract incentives. An additional element of PBL is gain sharing, which ensures the contractor's profit and the government's increased performance at a reduced cost. Based on the elements of PBL, the objectives of this project include; 1) comparing the actions/activities/accomplishments of the contract to the goals of PBL, 2) measure and appraise the attainment of those goals 3) provide information about the major factors causing the observed effects on the above, and 4) identify and analyze the metrics and incentives for their effectiveness in achieving the desired outcomes.

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guarantee. Our research also determined that the reliability metric was inappropriate for measuring and tracking APU reliability improvements. Additionally, disincentives were provided for not meeting contract requirements with the only contract incentive being the award term contract arrangement. Our report provides recommendations specific to the APU TLS contract and other recommendations for other PBL applications. These recommendations include an alternative contract pricing and gain sharing methods and appropriate metrics and incentives that reflect the true definition of PBL.

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LIST OF ACRONYMS

AFM	Aviation Fleet Maintenance
AIMD	Aviation Intermediate Maintenance Department
APU	Auxiliary Power Unit
ATAC	Advanced Traceability and Control
AVDLR	Aviation Depot Level Repairable
AWP	Awaiting Parts
BCA	Business Case Analysis
BCM	Beyond Capability of Maintenance
CRC	Component Repair Conference
D-level	Depot Level Maintenance
DDD	Defense Distribution Depot
DLR	Depot Level Repairable
DMMH	Direct Maintenance Man-hours
DOP	Designated Overhaul Point
DSP	Designated Supply (Support) Point
FAR	Federal Acquisition Regulations
FISC	Fleet Industrial Supply Center
I-level	Intermediate Level Maintenance
INWK	In work
LDT	Logistics Delay Time
LECP	Logistics Engineering Change Proposal
LMDSS	Logistics Management Decision Support System

MAL	Malfunction Code
MALS	Marine Aviation Logistics Squadron
MDT	Mean Down Time
MFHBUR	Mean Flight Hours Between Unscheduled Removals
MTBM	Mean Time Between Maintenance
NADEP CP	Naval Aviation Depot, Cherry Point
NAVAIR	Naval Air Systems Command
NAVICP	Naval Inventory Control Point, Philadelphia
NIIN	National Item Identification Number
NRFI	Not Ready for Issue
NWCF	Navy Working Capital Fund
OFPP	Office of Federal Procurement Policy
O-level	Organizational Level Maintenance
OMB	Office of Management and Budget
PBA	Performance Based Agreement (Acquisition)
PBFR	Price by Flight Hours
PBL	Performance Based Logistics
PBSA	Performance Based Service Agreement
PM	Program Manager
RFI	Ready for Issue
SOO	Statement of Objectives
SOW	Statement of Work
TLS	Total Logistics Support

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I. INTRODUCTION

A. IMPORTANCE

The purpose of this MBA project is to evaluate and assess the metrics, incentives and other terms and conditions of the Performance Based Logistics (PBL) contract between Naval Aviation Inventory Control Point (NAVICP) and Honeywell in support of FA-18/S-3/P-3/C-2 Auxiliary Power Unit (APU) to determine if the contractual terms and conditions established are effective in facilitating and encouraging the full potential of PBL savings and improved performance. PBL is a fairly recent initiative and mandate within the Department of Defense (DoD). The potential for savings and improved performance is enormous. While the potential value of PBL is undisputed, the art of effective execution raises many questions regarding the achievement of PBL goals and efficiencies. More is required than simply forming a public/private partnership to fully realize the potential of a PBL initiative. Reviewing the anatomy and effectiveness of these public/private partnerships is important in determining if appropriate metrics, incentives, and other measures are being used to form effective contractual relationships that facilitate and encourage achieving the full potential of PBL savings and improved performance. Our analysis of the Honeywell Total Logistics Support (TLS) contract will provide objective feedback and serve as a knowledge base for other PBL applications to use.

B. BACKGROUND

In accordance with the FY 2003-07 Defense Planning Guidance, DoD Directive 5000.1 (2003a), Quadrennial Defense Review (OSD, 2001), and OSD-ATL (2002), DoD has mandated the use of PBL practices. Compliance with the aforementioned directives has spawned many PBL initiatives within DoD. One of the first PBL Partnerships was Honeywell being contracted to provide TLS for the Auxiliary Power Unit (APU) common to the FA-18/S-3/P-3/C-2 aircraft.

An APU is a small gas turbine engine, with its own subsystems and components, used to provide electrical, hydraulics or air pressure independent of the aircraft main engines. The APU is mainly used to start the aircraft main engines before flight and during ground engine runs. The APU is also operated during ground maintenance checks to provide electrical or hydraulics power in the absence of support equipment. The APU is rarely used in flight, except for some in-flight emergencies. The APU models for the FA-18, S-3, P-3 and C-2 are the GTC36-200, GTCP36-201, GTCP-95-2/3/10, and GTCP36-201(C) and GTC85-116, respectively.

According to Candreva, Hill, Marcinek, Sturken and Vince (2001), during the late 1990s there were readiness problems with the APU common to the FA-18/S-3/P-3/C-2 aircraft. Aircraft availability suffered because of backlogged APU requisitions with an average Depot overhaul turnaround time of more than sixty days and shortages of piece parts required for the depot overhaul (Candreva et al., 2001). Honeywell initially provided NAVICP with a proposal to conduct the depot overhaul of the APU, but NAVICP also wanted to fix the low readiness and parts shortages. Additionally, Fleet concerns included improved availability and reliability, and reduced cost per flying hour. Honeywell's second proposal, similar to commercial support practices, "provided a total logistics support package including overhaul, field service engineering, technical manual maintenance and supply chain management of the APU and associated piece parts" (Candreva et al., 2001). Honeywell was subsequently contracted to provide TLS for the APU.

TLS for the APU includes overall program execution, customer and engineering support, total asset visibility, configuration and obsolescence management, quality assurance, repair and overhaul of the APU, and continuous improvement with guaranteed increases in availability and reliability. Under this PBL contract, Honeywell is providing program management, engineering expertise and process infrastructure, while subcontracting with Naval Aviation Depot Cherry Point (NADEP CP) for the repair and overhaul "touch labor" in conjunction with Caterpillar conducting third party logistics services such as online shipping and inventory management.

1. Contract Relationships

a. Honeywell

Honeywell Inc. was formally established in 1963 and is headquartered in Morristown, New Jersey. Honeywell is a leader in technology and manufacturing of; 1) aerospace products and services, 2) control technologies for buildings, homes and industry, 3) automotive products, 4) power generation systems, and 5) specialty chemicals; fibers; plastics and advanced materials. Honeywell Aerospace's capabilities include systems ranging from single-engine piston-powered airplanes to commercial applications to military and space vehicle applications (http://www.honeywell.com/sites/honeywell/).

Under the TLS APU contract, Honeywell Defense and Space Logistics, located in Tempe, Arizona, will execute 20 percent of the work and eighty percent will be performed at Cherry Point, NC (DoD, 2002).

b. Caterpillar

Caterpillar was established in 1925 and is headquartered in Peoria, Illinois. Caterpillar is a leading manufacturer of construction and mining equipment, natural gas and diesel engines, and industrial turbines. Caterpillar also provides technology in construction, transportation, mining, forestry, energy, logistics, electronics, financing and electric power generation (http://www.cat.com/cda/layout?m=38028&x=7). Caterpillar products are produced in forty-nine U.S. locations and in fifty-nine locations abroad.

The subsidiary, Caterpillar Logistics Services, was established in 1987 to provide logistics know-how to other firms. Caterpillar Logistics Services (CATLOG) currently serves sixty-five companies with emphasis on supply chain performance by providing logistics support for inbound service parts and finished goods. Clients represent a variety of industries including automotive, aerospace and defense, energy, manufacturing, technology, communications, industrial products, and consumer durables (http://www.catlogistics.com/s_industry_expertise/index.html).

c. NAVICP

Naval Inventory Control Point (NAVICP) provides program and supply support for Naval weapons systems. NAVICP supports 5,844 aircraft, 370 ships, and 74 submarines with annual sales of $4.2 billion. NAVICP was formed in 1995 by merging the Aviation Supply Office (ASO) in Philadelphia and the Ships Parts Control Center (SPCC) in Mechanicsburg. The Philadelphia site focuses on aviation and weapon system support, whereas the Mechanicsburg site provides support for hull, electrical, mechanical and electronic components, and repair parts for ships, submarines, and weapon systems (http://www.navicp.navy.mil/abouticp/index.htm).

In 2001, NAVICP announced that they were going to buy performance and manage supplier relationships in lieu of buying inventory and stocking warehouses to fill customer demand (Sara & Garvey, 2004). Instead of buying inventory, the Navy will buy a support package with guaranteed availability, improved reliability, and obsolescence management (Sara & Garvey, 2004). Moving from an inventory-based support approach to a performance-based concept is indicative of DoD’s implementation of PBL.

Under the PBL approach, suppliers are provided incentives to take on additional supply chain roles typically performed by NAVICP, Defense Logistics Agency (DLA), and depot repair activities. By assuming these roles, the supplier acquires the ownership and flexibility necessary to insert improvements into various supply chain processes. The supplier can then pass on these improvements to the customer in the form of better logistics support at lower overall costs. This translates into improved performance and increased profits for the supplier, while reducing total ownership costs over a weapon system’s life cycle and continuing to meet customer demands.

d. NADEP CP

NADEP CP is one of three Navy repair depots and is located aboard Marine Corps Air Station Cherry Point, North Carolina. NADEP CP provides extensive maintenance and engineering support for Navy and Marine Corps, other military, and government aircraft. Initially established in 1943 as the Overhaul and Repair

Department, NADEP CP has grown into a large facility covering almost 150 acres. Today NAPEP CP employs a variety of civilian, military, and government contracted workers capable of providing touch labor, repair and overhaul, and engineering support (http://www.nadepcp.navy.mil).

C. SCOPE, AND LIMITATIONS

The object of our review is to evaluate and assess the metrics, incentives, and other terms and conditions of the PBL TLS contract between Naval Inventory Control Point (NAVICP) and Honeywell Corporation. This project does not focus on contractor performance or contract execution, but rather the effectiveness and appropriateness of the terms and conditions of the contract. The current contract encompasses the FA-18/S-3/P-3/C-2/C-130 APU, the P-3 EDC and FA-18 MFC, but we will focus only on the FA-18/S-3/P-3/C-2 APU and other components listed in the SOW (2000) Equipment List. A crucial step in establishing objective feedback is reviewing and analyzing the terms and conditions agreed to in the Honeywell public/private partnership. The review and analysis will provide Program Managers (PM) and other government officials a knowledge base for forming effective contractual relationships in attaining the full potential of PBL through reduced total life cycle costs and improved weapon systems performance.

In providing the objective feedback, we will investigate the terms and conditions of the Honeywell APU TLS contract to include contract pricing, performance metrics, and incentives. Contract pricing is based solely on actual flight hours flown and will be reviewed to determine if this arrangement is an appropriate pricing method. We will examine the definition of the specified performance metrics to determine the effectiveness of the metric in achieving improved weapon systems performance. We will also assess the incentives of the contract to the extent of their ability to motivate contractor's performance in achieving the desired outcomes. Other terms and conditions of the contract to be examined include the gain share clause and contract exit provisions. Finally, we will look at the activities of the contract to determine if they achieved the goals of PBL which include compressing the supply chain, removing non-value added steps, reducing the logistics foot print and total ownership costs, and improving APU reliability. For this project, total ownership costs will be limited to Aviation Depot Level Repairable (AVDLR), Aviation Fleet Maintenance (AFM), Depot Repair, and Direct Maintenance Man Hours (DMMH) costs. Additionally, identifying the specific non-value added steps that were eliminated is beyond the scope of this project.

A limitation of this project was the lack of scholarly journals and other resources specific to the Honeywell TLS APU contract. Another limitation of this project was the inability to obtain a copy of the original Business Case Analysis, citing proprietary data, which could not be released.

D. METHODOLOGY

A literature review of DoD and service policies and procedures, government reports, magazine articles, internet-based materials and other library information was conducted. From these reviews, a basic understanding of the current policies and the elements related to PBL was developed. The review of government policy included: Office of the Secretary of Defense (OSD) Quadrennial Defense Review Report (QDR), DoDInst 5000 series, Federal Acquisition Regulations (FAR), and various OSD, Undersecretary for Acquisition, Technology, and Logistics (OSD-ATL) memorandums and policy statements regarding PBL. Additional information included DoD guides to applying and implementing PBL.

Informal research and questions were conducted by e-mail and telephone with military department officials at the headquarters and major acquisition commands regarding the history and reasoning for the terms and conditions of the contract, and other pertinent information.

Primary data was compiled and analyzed using the steps discussed below.

1. Aircraft Maintenance Data

Unscheduled removals were generated using the Maintenance Action Form (MAF) Report from the Detailed Analysis module within the Logistics Management Decision Support System (LMDSS), a Naval Air Systems Command (NAVAIR) maintenance data application. Maintenance actions at the O-level were the only records reviewed. The following query filters were used.

Start Date: 1998-10-01
End Date: 2004-09-30
TEC: ACWA, AMAA, AMAE, AMAF, AMAG, APBD, APBK, ASBE
Partno: Part Numbers are listed in SOW (2000) Attachment I, APU TLS Contract Equipment List
AT Code: R
TR Code: 23

Selected data was then copied to Microsoft Excel, where the scheduled maintenance actions (MAL codes 800 through 811) were deleted. Cannibalization actions (MAL codes 812 through 818) were counted separately from the unscheduled removals. Mean Flight Hours between Unscheduled Removals (MFHBUR) was calculated per the definition in the Statement of Work (SOW). Appropriate graphs and charts were developed using Microsoft Excel graphing functions.

2. O-Level and I-Level Maintenance Repair Costs

To generate monthly costs for each Type Equipment Code (TEC), the Reliability/Supportability/Cost Matrix report available within LMDSS was used. The following filters were used:

Start Date: 1998-10-01
End Date: 2004-09-30
TEC: ACWA, PBCA, PDGA, AMAA, AMAE, AMAF, AMAG, PBA, APB, PE, ASB, PBB

The output was compiled using Microsoft Excel. National Item Identification Numbers (NIINs) from the SOW (2000) Equipment List were extracted to determine annual fiscal year Aviation Depot Level Repairable (AVDLR), Aviation Fleet Maintenance (AFM), and Direct Maintenance Man-hour (DMMH) costs. The costs were discounted to FY99 dollars using LMDSS Inflation Factors Raw Index for O&MN (Purchases). Appropriate graphs and charts were developed using Microsoft Excel graphing functions.

3. Depot Repair Costs

Depot repair costs were generated using the Item Value to Depot Repair Cost Report from the Cost Analysis Section within LMDSS. The report was run for each APU TEC and individual fiscal years to generate annual depot repair costs. The costs were discounted to FY99 dollars using LMDSS Inflation Factors Raw Index for O&MN/LF (Composite). The following filters were used:

Start Date: 1998-10-01
End Date: 2004-09-30
TEC: PBCA, PDGA, PBA, PE, PBB
NIIN selection criteria: Select default TEC
NIINs To Display: 100
Sort By: Depot Repair Cost

Selected data was then copied to Microsoft Excel, where the data was sorted by NIIN and the NIIN's not included in the SOW (2000) Equipment List were deleted. The data was then sorted by date and the Depot Repair Costs were subtotaled to obtain total FY costs for each T/M/S. Appropriate graphs and charts were developed using Microsoft Excel graphing functions.

E. ORGANIZATION OF THE STUDY

The MBA Project consists of five chapters. Chapter I is an introduction to the project and provides the importance, background, scope, and methodology of the project.

Chapter II provides a review of PBL literature, including DoD and commercial policies, practices and definitions, to determine the elements required for a successful application of PBL. Specific discussion areas in establishing a PBL framework include the goals of PBL, appropriate metrics, and proper incentives for achieving the desired output.

Chapter III uses the framework established in Chapter II and presents data specific to the Honeywell APU TLS PBL contract. This framework entails: Price by Flight Hour Rates (PBFR), Performance Metrics (availability and reliability), and Gain Share, compressing the supply chain, elimination of non-value added steps, cost elements, APU performance, the logistical footprint, and finally exit provisions.

Chapter IV provides a qualitative and quantitative analysis of the data presented in Chapter III.

Chapter V summarizes the findings of the research and presents recommendations for applying PBL concepts.

II. PERFORMANCE-BASED LOGISTICS (PBL)

PBL is an acquisition reform initiative to improve weapon system logistics. The Defense Acquisition Guide Book (DoD, 2004) defines PBL as follows:

> The purchase of support as an integrated, affordable, performance package designed to optimize system readiness and meet performance goals for a weapon system through long-term support arrangements with clear lines of authority and responsibility. Application of Performance Based Logistics may be at the system, subsystem, or major assembly level depending on program unique circumstances and appropriate business case analysis (DoD, 2004).

PBL is intended to buy measurable outcomes, not transactional goods and services, with the measures of effectiveness based on war fighter stated performance requirements. A PBL strategy is an agreement in which the provider is given incentives and empowered to meet overarching customer oriented performance requirements to improve product support effectiveness.

PBL is the preferred approach to implement product support (DoD, 2003a). Product support is defined as a package of logistics support functions necessary to maintain the readiness and operational capability of a system or subsystem. Product support is an integral part of the weapon system support strategy that PMs are required to develop and document as part of their acquisition strategy (DoD, 2003b). This strategy includes implementing PBL at the weapon systems platform level as the preferred weapons system support strategy. The Government Accountability Office [GAO] (2004) reviewed industry PBL practices to identify industry lessons learned that could be useful to the DoD. The OSD-ATL proposed guidance to adopt PBL at the platform level "could limit competition, might not be the most cost effective approach and is inconsistent with the way private sector uses PBL" (GAO, 2004). In the air carrier industry, time and material contracts are more prevalent with PBL being used when appropriate system performance data are available for establishing a meaningful baseline for ensuring the contract arrangements are cost effective.

PBL is intended to increase weapon system readiness through cost-effective, integrated, logistics chains and public/private partnerships (OSD-ATL, 2004a). PBL is a product service support strategy that transfers traditional organic support to the supplier with a guaranteed level of performance at less than or equal to current cost. The level of performance for logistics support will be based on war-fighter stated performance requirements (OSD-ATL, 2004a). "Instead of buying set levels of spares, repairs, tools, and data, the new focus is on buying a predetermined level of availability to meet the war-fighter's objectives. Program managers strive to achieve two primary objectives. First, the weapon system as designed, maintained, and modified must continuously reduce the demand for logistics. Second, logistics support must be effective and efficient, and the resources required to fulfill logistics requirements, including time, must be minimized. As a product support strategy, PBL serves to balance and integrate the support activities necessary to meet these two objectives" (OSD, 2001).

A. GOALS OF PBL

To achieve the above objectives, the goals of PBL include: 1) compressing the supply chain; 2) eliminating non-value added steps; 3) reducing total ownership costs; 4) improving weapon system readiness and reliability; and 5) reducing logistics footprint. These goals were specified by the Department of Defense (DoD) implementation of PBL through the following references. The Quadrennial Defense Review calls for a business approach and appropriate metrics to "compress the supply chain, eliminate non-value added steps, reduce total ownership cost (TOC), and improve readiness" (OSD, 2001). OSD-ATL (2002) and in accordance with the FY 2003-07 Defense Planning Guidance, directed Service Acquisition Executives (SAEs) to submit plans for the application of PBL to all new weapons systems and all fielded ACAT I and II programs (OSD-ATL, 2002). DoD Directive 5000.1 (2003a) directed that:

> PMs shall develop and implement PBL strategies that optimize total system availability while minimizing cost and logistics footprint. Trade-off decisions involving cost, useful service, and effectiveness shall include the best use of public and private sector capabilities through government/industry partnering initiatives, in accordance with statutory requirements (DoD, 2003a).

At the user level, Naval Air Systems Command Instruction (NAVAIRINST) 4081.2A (2004b) draws upon the higher level documents and prescribes eight principles for a successful PBL program. The eight principles are as follows:

1. It procures an outcome (stated as a level of performance) rather than specific products or services.

2. It incentivizes the provider by linking payment to actual performance. Incentives may include firm fixed type contracts, extended contract periods, and monetary incentives. It also provides program stability, which allows providers to make long term commitments resulting in cost savings to both the contractor and the Navy.

3. It implements realistic, easily understood performance metrics. Performance metrics for PBLs will be stated in terms of readiness, availability, reliability, etc.

4. It tells the provider what the government wants instead of how to do it. However, the Government reserves the right to direct engineering changes, when necessary. NAVAIR will generally issue a Statement of Objectives (SOO) for the PBL that provides top-level program objectives and allows providers maximum flexibility in tailoring and proposing an innovative and cost effective Statement of Work (SOW) to satisfy the SOO requirements.

5. The PBL should empower the provider with the authorization and responsibility to control those elements required to successfully support the program. The following are examples of the functions that may be delegated to the provider:

- Obsolescence Management
- Public/Private Partnerships
- Requirements Determination and Acquisition
- Packaging, Handling, Storage and Transportation
- Warehousing
- Engineering and Technical Services
- Technology Insertion
- Configuration Management
- Retrograde Management
- FMS Support (if applicable)

6. It reduces the logistics footprint.

7. It has minimal or no impact to the Fleet. This means the PBL is essentially transparent, posing no additional tasking on Fleet maintainers and no additional impact to any other product support elements.

> 8. It mitigates long term risk by ensuring exit provisions are included in the contract/agreement to facilitate the re-establishment of organic or commercial support capability, if needed (NAVAIR, 2004b).

The above principles reinforce the goals of PBL and provide for, among other things, easily understood performance metrics and incentives to achieve the required performance.

B. METRICS

A guiding principle in conducting a business case analysis (BCA) for PBL states: "war fighter requirements will be linked to metrics and metrics will be linked to contract incentives" (OSD-ATL, 2004a). The requirements will be documented in a Performance Based Agreement (PBA), which specifies the objectives of logistics support agreed upon by the war fighter and the PM. The PBA is the foundation for the PBL program and will be used to conduct the BCA and write the Request for Proposal (RFP), SOO and Statement of Work (SOW).

As stated above, the PBA provides the foundation for the PBL effort. The Defense Acquisition Guidebook states:

> For Performance Based Logistics, "performance" is defined in terms of military objectives, using the following criteria:
>
> 1. Operational Availability. The percent of time that a weapon system is available for a mission or ability to sustain operations tempo.
>
> 2. Operational Reliability. The measure of a weapon system in meeting mission success objectives (percent of objectives met, by weapon system). Depending on the weapon system, a mission objective would be a sortie, tour, launch, destination reached, capability, etc.
>
> 3. Cost per Unit Usage. The total operating costs divided by the appropriate unit of measurement for a given weapon system. Depending on weapon system, the measurement unit could be flight hour, steaming hour, launch, mile driven, etc.
>
> 4. Logistics Footprint. The government / contractor size or "presence" of logistics support required to deploy, sustain, and move a weapon system. Measurable elements include inventory / equipment, personnel, facilities, transportation assets, and real estate.
>
> 5. Logistics Response Time. This is the period of time from logistics demand signal sent to satisfaction of that logistics demand. "Logistics Demand" refers to systems, components, or resources, including labor, required for weapon system logistics support (DoD, 2004).

The Guidebook further states that: “PBL metrics should support these desired outcomes” (DoD, 2004).

Table 1. NAVAIRINST 4081.2A Performance Metrics

Performance Outcomes	Metrics/Considerations
Operational Availability (Ao)	A(o) - (Under Full CLS Only) Readiness Mission Capable Rates Sortie Generation Rate Turn- Around-Times Surge Requirements Reduced Down Time
Operational Reliability	Sortie/Mission Completions Time On Wing Mean Time Between Failures (MTBF) MTBF Improvement No Fault Found/Reduction Elimination
Cost Per Unit Usage	Cost Per Flight Hour Annual FFP Cost (prorated by units) Obsolescence Management Attrition Replacement Sustaining Engineering/ECP Costs Total Ownership Cost (TOC)
Logistics Footprint	Maintenance Planning Reliability improvement Reduced Cannibalizations Support Equipment Training Publications Inventory Needs Staffing Levels
Logistics Response Time	Parts Availability First Pass Effectiveness Maintainability P,H,S&T Mean Logistics Down Time Supply Chain Management
Source: NAVAIR, 2004b	

As shown in Table 1, NAVAIR (2004b) provides a list of individual performance metrics to address the above performance categories. The issue with Table 1 is that excess metrics can make managing the PBL program extremely difficult and costly, negating the benefits of PBL. This same instruction states: “develop a few simple metrics with dependable measurement tools" (NAVAIR, 2004b). The Defense Acquisition Guidebook (DoD, 2004) also suggests; "focusing on a few outcome measures such as weapon system availability, mission reliability, logistics footprint and overall system readiness levels" (DoD, 2004). The Defense Acquisition Guidebook and the Program Managers Guide (DoD, 2001) then provides a list of top-level performance outcomes, which is in contrast to focusing on a few outcome measures. This list includes "requisition fulfillment rate, customer wait time, ratio of supply chain costs to sales, maintenance repair turnaround time, and so on" (DoD, 2001) and "outcomes include, but are not limited to, not mission capable supply (NMCS), ratio of supply chain costs to sales, maintenance repair turnaround time, depot cycle time, and negotiated time definite delivery" (DoD, 2004).

According to Doerr, Eaton, and Lewis (2004), "since PBL buys outcomes then the focus should be on the significant output measurements and those process measurements where an operational decision depends on that process information." Significant output measurements would include operational availability and weapon system reliability. Process measurements are related to the series of events required to produce an end item or service such as repairing or overhauling an APU or other spare parts. The process measurements where an operational decision would depend on the information would include maintenance repair turnaround time, depot cycle time, and requisition fulfillment rate. Process measurement metrics should only be used when they add value and an operational decision depends on that information.

NAVAIR (2004b) provides additional considerations for establishing appropriate metrics. These considerations include the following: "1) use of war fighter supportability-related performance requirements, 2) identification of realistic, consistent and readily quantifiable metrics, 3) identification of the source and data to be collected, 4) identification of roles and responsibilities for analysis and reporting of performance data, 5) description for the data elements and formula for calculating the critical metrics, and 6) statement of the frequency and format for reporting results" (NAVAIR 2004b).

Based on the above, a successful PBL program would select only a few realistic, consistent, and easily quantifiable outcome measures of effectiveness focused on significant operational performance and those value added process measurements. Additionally, according to Kotlanger and Giuntini (2005), the activity responsible for the metric should have control of the variables that affect the metric. Basically, contracting for operational availability is difficult because the contractor does not have control of all of the inputs such as maintenance, training, spare parts, etc. The PM should specify the higher metric and then let the contractor decide the lower metrics required to achieve the goal. If the PM specifies the lower metrics, then the contractor loses the flexibility to efficiently meet the performance goals.

C. CONTRACT TYPES

As established by OFPP and OMB (2005), contract types vary in terms of degree and timing of risk assumed by the contractor and the amount and nature of the profit incentive offered to the contractor for meeting or exceeding specified standards or goals. Government contracts are designed to obtain specific acquisition objectives by: “1) establishing reasonable and attainable targets that are clearly communicated to the contractor; and 2) including appropriate incentive arrangements designed to motivate contractor efforts that might not other wise be emphasized and discourage contractor inefficiency and waste” (OFPP & OMB, 2005).

On each side of the contractual spectrum lie two categories of contracts. At one end of the contractual spectrum is the Firm-Fixed-Price (FFP) Contract, under which the contractor is fully responsible for performance costs and enjoys (or suffers) resulting profits (or losses). At the other end of the spectrum is the Cost-Reimbursement (CR) Contract, in which allowable and allocated costs are reimbursed and the negotiated fee (profit) is fixed, whereby the contractor has minimal responsibility for or incentive to control performance costs. As you move from one end of the spectrum to the other, each category of contract is broken down into type specific contracts, which are designed around risk and incentives. Risk is the driving factor as to which type of contract under these two categories will be utilized by the Government to limit risk while simultaneously providing the contractor with the greatest incentive for efficient and economical performance (Hearn, 2001). The various contract types in a PBSSA agreement are discussed below.

1. Fixed Price Contracts

The basic types of fixed price contracts are firm-fixed-price and fixed-price with economic price adjustment. Fixed price contracts are the standard business pricing arrangement and according to OSD (2004b), "wherever possible PBL contracts should be fixed price (e.g., fixed price per operating or system operating hour)." "Under fixed price contracts the contractor agrees to supply specified goods or deliverables in a specified quantity or to tender a specified service or level of effort (LOE) in return for a specified price, either lump sum or a unit price" (Garrett, 2001). Under fixed price type contracts, the risk is shifted mostly onto the contractor to deliver the goods or services agreed upon and allows for potential higher profit for the contractor due to the contractor controlling his costs. The fixed price contract provides maximum incentive for the contractor to control costs and minimizes the administrative burden on the Government.

2. Cost-Reimbursement Contracts

The basic types of cost-reimbursement contracts are cost-plus-fixed fee, cost-plus-award fee, and cost-plus-incentive fee. "Cost-reimbursement contracts usually include an estimate of project cost, a provision for reimbursing the seller's expenses, and a provision for paying a fee as profit" (Garrett, 2001). Use of cost-reimbursement contracts require certain measures not used with fixed-price contracts such as definition, measurement, allocation, and conformation of costs due to the shift in risk to the buyer.

3. Incentive Fee Contracts

Incentive fee contracts are designed to obtain specific acquisition objectives by relating the amount of profit or fee payable under the contract to the contractor's performance. Incentive fee contracts can be either FP or CR type contracts and are tailored towards the amount of risk the Government feels the contractor can assume. Fixed-price incentive contracts are preferred when project cost and performance are reasonably certain and a final price ceiling is negotiated at the outset. Cost-reimbursement incentive contracts are tailored to the overall cost-reimbursement agreements that are built around a target cost, target fee, minimum and maximum fees and a fee adjustment formula (FAR 16.405).

4. Award Fee Contracts

"Award fee contracts provide a means of applying incentives in contracts that are not susceptible to finite measurements of performance necessary for structuring incentive contracts" (Garrett, 2001). The two types of award fee contracts are fixed-price award fee (FPAF) and cost-plus-award fee (CPAF). Under FPAF contracts, cost incentives are not applied until the completion of the contract. Any award fee earned will be paid in addition to the fixed price. The fee established in a CPAF contract consists of a base fee and an award fee pool. "The base fee is a set amount that does not vary with performance, while the award fee pool is used as a motivator for contractor performance in areas such as quality, timeliness, and cost effectiveness" (Hearn, 2002).

5. Award Term Contracts

With award term contracts, the government establishes objective outcomes that it wants the provider to deliver. Successful performance leads to a longer-term contract period without having to compete for the award. Conversely, unsuccessful performance means a shorter contract period. This approach enables providers to make investments to improve performance and reduce costs that they might not otherwise make when facing uncertainty or short-term periods of performance (DoD, 2001). Additionally, rewarding contractors with long-term relationships may provide a more powerful incentive than extra profit. "Profit earned over an extended period of time is better aligned with the strategic goals of the company; therefore, exerts greater influence on contractor performance" (Stevens & Yoder, 2005). Award term contracts facilitate the "preferred PBL contracting approach by using long term contracts with incentives tied to performance that provide industry with a firm period of performance" (OSD, 2004b).

D. INCENTIVES

Incentives are an essential element in unleashing the contractor's creativity and are the basis for Performance-Based Service Agreements (PBSA). To ensure successful PBSA contracts, incentives should be built upon performance objectives and standards. The incentives are based on meeting target performance standards, not minimum contract length. The performance objectives and standards specified must be measurable and attainable.

Incentives should be applied selectively to motivate contractor efforts in areas that might not be emphasized, and to discourage inefficiencies. Incentives should apply to the most important aspects of the work, rather than the individual task. Incentives are especially useful in efforts that are complex, have high-dollar value, or have a history of performance or cost overrun problems. Incentives should correlate with results. Agencies should avoid rewarding contractors for simply meeting minimum standards of contract performance, and create a proper balance between cost, performance, and schedule incentives to achieve or exceed program goals.

Incentives can be monetary, non-monetary, positive, or negative and should reflect value to both the government and the contractor. The incentives can be based on cost, schedule, or performance. Under a negative or disincentive, if the contractor fails to meet a specified performance metric, then the government would penalize the contractor by levying a monetary penalty at time of payment. As the Office of Federal Procurement Policy [OFPP] and Office of Management and Budget [OMB] (1998) states: "The incentive amount should correspond to the difficulty of the task required, but should not exceed the value of benefits the government receives." OSD-ATL (2001) also states: "regardless of the final composition and structure of the contract, the goal is to encourage and motivate the contractor's optimal performance for logistical support through reduced cycle time, reduced inventory, improved reliability/obsolescence management, and reduced total ownership costs."

One of the keys to motivate the contractor's optimal performance involves recognizing and acting on the private sector's profit motive. For a contractor in the application of PBL, revenue is not important. According to Kotlanger and Giuntini (2005), the contractor has to have a material improvement in profit. "Without an improvement in profit there is no incentive to take on the risks associated with PBL programs" (Kotlanger & Giuntini 2005). Cost, performance, and delivery incentives are all examples of rewards that can motivate a contractor to improve performance and reliability, thereby increasing the contractor's profit and the efficiency and effectiveness of the government's weapon system. In the application of PBL, revenue will stay the same or decrease, but the contractor actively reduces costs to achieve efficiency and effectiveness, thereby creating more profit. The government, source of revenue for the contractor, pays less. The contractor refines their processes, while expanding his profit margins. Weapon system performance (availability, reliability and supportability) and process efficiency (operations, maintenance and logistics) are increased. For PBL to be successful, the government has to allow higher profits and not re-baseline contracts once the contractor begins to realize profit.

According to Kotlanger and Giuntini (2005), gain sharing can be used as an incentive to not re-baseline contracts. “Gain sharing recognizes both the government’s and contractor’s self interests by providing incentives versus penalties, empowerment versus oversight, Profits as incentives versus capped profits” (Kotlanger & Giuntini 2005). Gain sharing involves allowing the contractor his profit, but then providing the government greater performance (reliability) rather than re-baselining the contract. The contractor gain shares with the government by providing greater reliability, while charging the government at a lower rate (i.e., 92% reliability at a rate for 90%). Both parties win because the contractor is profitable and the government gets better performance.

E. ELEMENTS OF A SUCCESSFUL PBL APPLICATION

PBL should be used when appropriate data are available for establishing a meaningful baseline for ensuring the contract arrangements are cost effective. The PBL application must achieve the goals of PBL. These goals are as follows: 1) compressing the supply chain; 2) eliminating non-value added steps; 3) reducing total ownership costs; 4) improving weapon system readiness and reliability; and 5) reducing logistics footprint. Additionally, as specified by NAVAIR (2004), exit provisions should be included in the contract/agreement to facilitate the re-establishment of organic or commercial support capability, if needed.

In meeting the above goals, a successful PBL program should buy measurable outcomes with measures of effectiveness based on war-fighter-stated performance requirements. War-fighter requirements should be linked to metrics and metrics should be linked to contract incentives. The measures of effectiveness should include only a few, simple, realistic, consistent and easily quantifiable metrics focused on operational performance and value added process indicators. Additionally, the PM should specify the higher operational metric and then empower the contractor with the flexibility and control to meet the operational performance goal.

According to OSD (2004b), the preferred performance based contracting approach is the use of long-term contracts (fixed price per unit of output or fixed price per unit per period) with incentives tied to performance objectives and standards that are measurable and attainable. An incentive to fully achieve the goals of PBL and to take on the associated risks is to allow the contractor to maximize profit through actively reducing costs and achieving efficient and effective operations. To gain maximum performance and program stability the government should allow higher profits and not re-baseline contracts. Payment of incentives, an essential part of PBSAs, should be directly linked to actual contractor performance and not duration of contract or other factors. The results of a successful PBL program would include the government paying less for services, the contractor improving his bottom line, and increasing weapon systems performance. Real success depends on the benefits to the war fighter and cost savings or avoidance.

III. DATA

This chapter uses the elements of a successful PBL application developed in the previous chapter as a framework for presenting the data and subsequent analysis specific to the terms and conditions of the Honeywell APU TLS PBL contract. The data to be presented includes PBFR, Performance Metrics (availability and reliability), incentives, the gain share clause, and exit provisions. Additional data to be presented consists of the actions, activities and accomplishments of the contract in pursuing the goals of PBL.

A. AVAILABLE DATA

The FA-18, S-3, C-2 and P-3 aircraft have logged thousands of flight hours while engaged in worldwide deployments and conflicts ranging from the attacks against Libya to Operation Desert Storm to ongoing Operation Iraqi Freedom. The P-3 entered the Navy's inventory during July 1962, with the P-3C model being operational since 1969. The last new P-3C rolled off the factory floor during April 1990. The first C-2A's flew during 1964, while the S-3B entered service during 1975. In 1984 thirty-nine new C-2A's were re-procured, while the older C-2A's were retired during 1987. The FA-18A/B models first flew during November 1978 and have been operational since October 1983. The FA-18C/D models have been in operation since a 1987 block upgrade to the FA-18A/B's. From their first flights, these aircraft have flown from shore bases and sea platforms in many different environments representing the full spectrum of factors that provide a complete picture of operational and logistical characteristics.

B. CONTRACT

"The contract awarded is a fixed price ten year Requirements contract. The contract includes a five year base ordering period and five additional one-year ordering periods" (SOW, 2000). The five additional one-year ordering periods will be awarded individually based on the contractor meeting the performance metrics (availability and reliability) specified in the contract. The only exception to the fixed price is annual lump sum equitable adjustments based on changing labor rates at NADEP Cherry Point.

Execution of the contract is provided in three phases. Phase I is the transition phase, which includes setting up the infrastructure, material and systems required to accomplish the TLS Program. Pricing for Phase I is based on a flat rate repair pricing schedule. Phase II is the TLS Program, which started on March 01, 2001. The TLS Program includes "the contractor supplying effort to provision, stock, repair, store and ship ready-for-issue (RFI) APUs directly to the user upon demand while meeting the performance requirements for availability and reliability" (SOW, 2000). Additional functions delegated to the contractor include obsolescence management, technology insertion, configuration management, and engineering and technical services. Pricing for Phase II is based on price by flight hour rates (PBFR). Phase III provides for exit provisions.

1. Price by Flight Hour Rates (PBFR)

Pricing for Phase II of the contract is provided on a cost per usage basis, which is based solely on actual aircraft flight hours flown. According to Tonoff,

> The PBFR rates were established based on existing factors such as obsolescence, reliability, level of repair required and readily available technology insertion. The FA-18's PBFR is less than other aircraft, because the FA-18's APU reliability is better (fewer unscheduled removals) and the FA-18 inventory is much larger and provides a greater base to allocate fixed and start-up costs than other aircraft (G. D. Tonoff, personal communication, August 26, 2005).

The contract provides two PBFRs, except for the C-2, with yearly increases over the life of the contract. The higher PBFR rate is used when the actual flight hours exceed the following levels: FA-18 – 120,000 hours, P-3 – 60,000 hours, and the S-3 – 22,500 hours. The C-2 aircraft carries only one PBFR Rate.

(Estimated Annual Flight Hours)X(PBFR)	Estimated Annual Contract Payment
- Availability Adjustment	Penalty for Parts Availability <90%
-Reliability Adjustment	Penalty for not achieving Reliability Guarantee
-Gain Share Adjustment	
+- NADEP CP Labor Rate adjustment	
Annual Payment	

Figure 1. Contract Payment Formula

The estimated annual contract payment, shown in Figure 1, is calculated by multiplying the government's annual estimated flight hours by the PBFRs. The annual contract payment is then divided by twelve months to determine the estimated monthly contractor invoice amount. On a monthly basis, the contractor invoices the government for actual aircraft flight hours flown, which are then multiplied by the PBFRs. Every six months, the government and contractor reconcile between estimated and actual flight hours. The money the contractor actually receives is adjusted annually for not meeting the performance metrics, for gain share adjustments and NADEP CP Labor Rate adjustments.

2. Performance Metrics

a. Availability

The SOW (2000) defines availability as: "the number of requisitions delivered within specified timeframes divided by the total number of requisitions received by the contractor, expressed as a percent". The contractor is expected to maintain at least 90% availability and is monetarily penalized for each percentage point below 90%. The penalty amount increases for availability equal to or less than 82%. Additionally, per the SOW (2000), the Government is required to return all retrograde to the contractor facility within thirty days after removal. If the retrograde is not returned within a timely manner, then the contractor can relax the availability performance metric to the level of the Government's Retrograde Return performance with associated reductions in penalties. "If the Government's Retrograde Return performance is rated at 87% then the contractor is only required to provide availability at 87% with subsequent 3% reductions in penalty assessments" (SOW, 2000).

To establish the availability penalty, a total pool of money was negotiated for disincentives. According to Tonoff, "most of the money was earmarked for delivery response time vice reliability as PBFR inherently provides incentives to improve reliability" (G. D. Tonoff, personal communication, August 26, 2005).

b. Reliability

The SOW (2000) defines reliability as:

> The Mean Flight Hours Between Unscheduled Removals (MFHBUR) of the APU assembly at the O-level. Unscheduled Removals includes all APU removals except those removed for Scheduled Maintenance, to facilitate access to other equipment or to update equipment (SOW, 2000).

MFHBUR is calculated as: "the total aircraft flight hours divided by the total unscheduled APU removals" (SOW, 2000).

The contract provides for guaranteed reliability improvements over the life of the contract at a fixed price. The guaranteed improvements are: FA-18 – 45%, P-3 – 300%, S-3 – 25%, and the C-2 – 15% (SOW, 2000). The contractor is expected "to apply the resources necessary to measure and improve MFHBUR during Phase II of the APU TLS Program" (SOW, 2000). The contractor is monetarily penalized for not meeting reliability improvement guarantees. To establish the reliability adjustment, a total pool of money was negotiated for disincentives. According to Tonoff, the reliability pool of money was established and then allocated over the number of aircraft with the C-2 being allotted proportionately less money than the other platforms (G. D. Tonoff, personal communication, August 26, 2005).

3. Gain Share

According to Tonoff,

> The Government will share in contract cost avoidances/savings in the event realized reliability improvements are greater than twenty five percent above the guaranteed minimum improvement identified for each aircraft platform. Above the twenty-five percent threshold, Honeywell will gain share with the Government at a rate of fifty percent of the cost avoidance (Tonoff, 2000).

Additionally, the SOW (2000) provides that: "If, after three years of PBFH performance, actual APU Mean Flight Hours Between Depot Demand (MFHBD) is equal to or greater than the Gain Share criteria, the contractor agrees to gain share with the government 50% of the APU repair cost avoidance. The gain share formula is shown in Figure 2. The gain share amount is recalculated each year during the annual payment reconciliation.

Predicted APU's repaired at Depot - Actual APUs Repaired at Depot
x Flat Rate APU Repair Price
Repair Cost Avoidance
x 50%

Figure 2. Gain Share Adjustment Formula

C. COMPRESS THE SUPPLY THE CHAIN

NAVSUP (2004) and Cruz (1997) describe the Naval Aviation Supply chain for Depot Level Repairables (DLR). This description is diagrammed in Appendix A and discussed below. Figure 3.1 in Cruz (1997) provides a detailed NADEP Induction Flow. The appendix and the description below is a basic view of the system, which is much more complicated and dynamic than described and depicted in our report.

Traditionally, DLR components are removed at the O-level and sent to the I-level for repair. For repairs completed at the I-level, parts are supplied by the Supply Department. "DLRs must be returned to the Designated Support Point (DSP) or Designated Overhaul Point (DOP) when they are Beyond Capable Maintenance (BCM) (not locally repairable) at the I-level" (NAVSUP, 2004). If determined to be BCM, the unit must be expeditiously shipped to the nearest Advanced Traceability and Control (ATAC) Node for collection, consolidation and trans-shipment to one of two ATAC regional hubs (East and West). The ATAC Hub provides long haul shipping to the Defense Distribution Depot (DDD) for storage and eventual delivery to NADEP CP per Designated Support Point (DSP) or Fleet Industrial Supply Center (FISC) direction. At NADEP CP, units are inducted and repaired and then returned to the DDD for storage and eventual delivery to the I-level. Upon receipt of the RFI item, the I-level restocks their supply shelves with the asset. APU consumables in support of repairs at NADEP CP are requested by a parts order from Depot artisans to the DSP or FISC with parts provided from the DDD. The DSP or FISC restock the DDD via NAVICP, DLA, and other FISCs.

Under the new arrangement, components are still removed at the O-level and processed for higher repairs via the I-level, the ATAC Node, and ATAC Hub. NRFI assets are sent to the Caterpillar Logistics (CatLog) warehouse instead of the DDD for forwarding to the Depot. As depicted in Appendix B, CatLog appears to be inserted into the DLR supply chain as a parallel entity to the DDD. CatLog, a Honeywell subcontractor, is now responsible for storing APU specific components and consumables and shipping to and from NADEP CP. Additionally, per the SOW (2000), Honeywell assumes responsibility for APU consumables management.. According to IG (2000), 1,503 consumables, in support of NADEP CP APU repairs, have been transferred from DLA management to Honeywell control. "DLA is a supply support organization, which is assigned management responsibility and control of items (3 and 9 cognizance symbol except 3H and 9Q) in common use by all military services" (NAVSUP, 2004). The transfer of consumables was made despite NADEP CP being the highest DoD consumer, with 34% of the requisitions for the APU specific consumable items (IG, 2000). DLA continues to maintain the same consumable inventory for other DoD customers.

D. ELIMINATE NON-VALUE ADDED STEPS

Identifying the specific non-value added steps that were eliminated is beyond the scope of this project, but the following results are indicators of the elimination of non-value added steps:

- APUs awaiting depot repair from 118 to zero
- Backorders reduced from 125 to 26 to zero
- Average Delivery Time from 35 days to 5.4 days
- 98% requisitions filled
- Supply Material Availability from 65% to 95%
  (Source: Lucyshyn, et al., 2005)

- Depot TAT from 162 days to 38 days
- Increased depot production by 70%
- Decreased labor hours by 47%
  (Source: Sara & Garvey, 2004)

These indicators suggest improved efficiencies, but the direct link between these indicators and the PBL contract is not clear. There is a possibility that these efficiencies were realized as a result of other variables that coincided with the NAVICP's PBL initiative and subsequent TLS contract with Honeywell.

According to HASC (2001), NADEP CP completed ISO 9000 certification in 1999, employed the Theory of Constraints and implemented Manufacturing Resource Planning (MRP II) and Enterprise Resource Planning (ERP) to offset increasing costs and repair cycles, reduce bottlenecks, counter material delays, and align production priorities with organizational goals (HASC, 2001). "Other best business practices implemented by NADEP CP include process consolidation, digitized publications and electronic availability of technical data" (JDMAG, 2005).

In addition to NADEP CP's initiatives, Honeywell implemented the best commercial practices for technology insertion, configuration management, and material management. Material management includes forecasting, procurement, and stocking of components required for the repair and overhaul of the APU and subcomponents. These efforts, among other things, improved the screening of NRFI assets was from an average 9.5 days to an average 2.5 days by reducing the misidentification of assets at the depot induction point. CatLog further streamlined the process by receiving units directly from the Fleet and positively identifying the item upon arrival rather than waiting for induction into the D-level. Implementing bar-coding of Repair Orders (RO) and serial numbers improved the material requisitioning process by improving accuracy, reducing rejections and delays for material delivery, and decreasing overall turnaround time (TAT) by three to five workdays per unit. The process was further improved by implementing electronic transmission of the work order directly to the CatLog warehouse and using online shipping and inventory management.

E. MAINTENANCE COST ELEMENTS

The Navy Working Capital Fund (NWCF) is a revolving account that relies on sales, AVDLR charges, rather than annual budget appropriations to finance operations such as Depot repair services. NWCF uses AVDLR charges and other surcharges to finance the fund on a break-even basis. An AVDLR charge (Net price of the asset) to the Fleet occurs when an I-level activity determines that the required repairs are beyond their capability of maintenance (BCM) and then transfers the asset to the Depot for repair. An

AVDLR charge, at a higher rate (Unit price of the asset), can also be incurred when a repairable asset is lost or missing. With the above process, the customer finances the

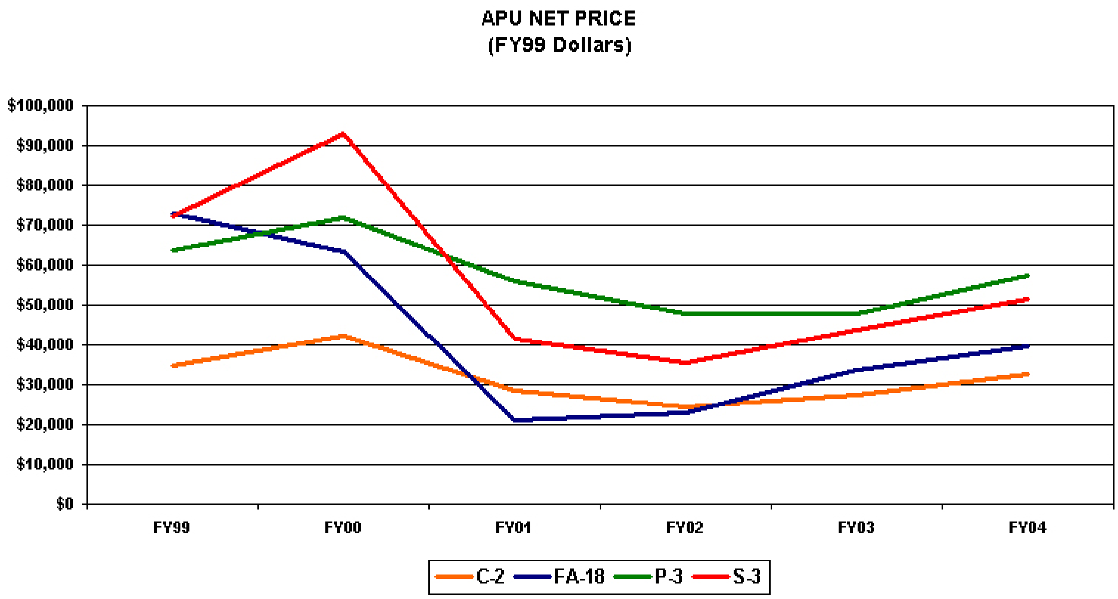

Figure 3. APU Net Price Reductions

Depot repairs. As shown in Figure 3, during FY01, start of Phase II for the APU TLS contract, the APU's Net Price (AVDLR charge) was reduced by 22%, 32%, 55% and 67% for the P-3, C-2, S-3, and FA-18, respectively. These significant reductions in Net Price were made "due to maintenance changes, Tier 1 pricing and and TLS contract savings" (DoDIG, 2001) and represents significant cost savings to the Fleet.

In determining overall costs, AVDLR, AFM, DMMH, and Depot Repair costs for each aircraft were analyzed to determine if these costs increased, decreased or resulted in no change at all. To avoid double counting costs, the greater of AVDLR or contract cost will be used in calculating total costs since AVDLR is used to pay for the contract. Cost data, in FY99 dollars, is presented in Appendix C, with column definitions provided in Table 2.

Table 2. Cost Element Column Definitions	
Column Heading	**Remarks**
AVDLR COST	Total repairable component costs
AFM COST	Total consumable item cost
DMMH COST	Total Direct Maintenance Man Hour costs
DEPOT REPAIR COST	Total Depot Repair cost
ESTIMATED CONTRACT COST	Total estimated Contract costs
TOTAL COSTS	Sum of the above costs using the greater of AVDLR or Estimated Contract Costs

F. APU PERFORMANCE

APU performance data is provided in Appendices IV and V. The explanation for each column heading is shown in Table 3.

Table 3. APU Performance Column Definitions	
Column Heading	**Remarks**
DATE	Year and month
FLTS TOT	Total number of actual flights for the month
FHRS TOT	Total actual flight hours for the month
REMS	Total number of unscheduled removals at the Organizational level for the month. Does not include scheduled maintenance or cannibalizations
CANNS	Total number of cannibalization actions during the month.
MFHBUR	Mean Flight Hours Between Unscheduled Removals. Calculated by dividing FHRS TOT by REMS.
MFLTSBUR	Mean Number of Flights Between Unscheduled Removals. Calculated by dividing FLTS TOT by REMS.

G. LOGISTICS FOOTPRINT

As established earlier in this document, reliability improvements, reduced cannibalizations, staffing levels, inventory/equipment needs, facilities, training, publications, and transportation assets are the elements to review to determine if the logistics footprint was reduced or not.

1. Reliability Improvements and Cannibalizations

As discussed in the analysis of APU performance, the only aircraft that demonstrated improved reliability is the P-3. As shown in Table 4, the number of cannibalizations show a decreasing trend. Cannibalizations increased for the FA-18 and P-3 during FY02 and FY03 due to Operations Enduring Freedom and Iraqi Freedom.

Table 4. Cannibalizations

	FY99	FY00	FY01	FY02	FY03	FY04
P-3	1	1	6	4	6	0
C-2	2	1	0	0	1	0
S-3	7	5	3	0	0	0
FA-18	8	5	6	12	4	5

2. Staffing Levels, Inventory and Equipment Needs, and Facilities

The SOW (2000) requires the government to provide a dedicated Procuring Contracting Officer (PCO) and Weapon Systems Manager (WSM). Per the SOW (2000), the PCO and WSM will act as primary points of contacts to the Contractor's PM for coordinating semiannual Program Management Reviews and oversight and management of the APU TLS contract. The SOW (2000) also establishes a Customer Satisfaction Board (CSB). The CSB includes government representatives to resolve configuration management issues.

Under the PBL contract, the maintenance plan changed with first-degree and second-degree repair of the APU at the I-level being transferred to the D-level at NADEP CP. The government is still responsible for on-equipment work at the O-level. The O-level on-equipment work encompasses removing and replacing the APU assembly from the aircraft and some APU external components. First-degree and second-degree repair of the APU entails major engine inspections, and complete tear down and overhaul. Third-degree repair includes preparing the APU for shipment and installation, preservation actions, building up and installing quick engine change kits, removal and replacement of external components, and test and check operations on the aircraft engine test cell. According to NAVAIR (2004a), only third-degree repair actions are authorized at the I-level activities, both ashore and afloat, except for MALS-11. Per NAVAIR

(2004a), MALS-11 is the only activity authorized first-degree repair on the GTCP36 APU.

For manpower, according to TECOM (2002) and NAVPERS (2004), a Military Occupational Specialty (MOS) or Navy Enlisted Classification (NEC) is assigned to a Power Plants Mechanic (USMC) or Aviation Machinist's Mate (Navy) for both the aircraft engine and the APU. As an example, MOS 6227 is responsible for repairing both the F404-GE-400/402 FA-18 engine and the GTCP36-200 APU.

For inventory and equipment needs, additional tools, test equipment, and maintenance fixtures and stands are required to conduct first-degree and second-degree maintenance over third-degree repairs. By eliminating first-degree and second-degree repair at the I-level, there is a potential for reduction in assets.

For facilities, as stated above, third-degree repair entails test and check operations requiring test cells and other equipment. Therefore, hangar bays, work centers and test cells remain in support of APU third-degree repair actions and other type model series engines and aircraft.

3. Training

TECOM (2002) and NAVPERS (2004) have not been updated to reflect third-degree engine repair at the I-level and still calls for qualifications in APU systems and major APU engine inspections. In addition to the MOS/NEC training, and at no additional cost to the Government, the contractor may provide informal field maintenance and operations training at the contractor's discretion. Per the SOW (2000), this training may be classroom instruction or on-the-job-training (OJT) and will include O-level and I-level operations and maintenance of support equipment and facilities for testing. Honeywell Field Service Engineers (FSE) conducts the contractor training.

4. Publications

Per the SOW (2000), the contractor is responsible for:

- Maintaining Intermediate and Depot level maintenance publications
- Issuing change notices to maintain accuracy of publications
- Updating Organizational publications when required due to contractor modifications that affect Organizational level maintenance

- Issuing Interim Rapid Action Changes (IRACs) from the contractor to the PCO
- Providing technical publication revisions via paper copy

NAVAIR and NATEC remain responsible for maintaining, printing, distributing, and updating publications in support of the entire aircraft minus the APU. NATEC is also responsible for providing updated distribution lists and remain responsible for APU O-level publications.

5. Transportation Assets

Per the SOW (2000), "the contractor shall ship all RFI requisitioned equipment to continental United States (CONUS) destinations and to OCONUS locations per specified attachments and schedules to meet the availability requirements". The SOW (2000) also specifies that: "the Government shall return all retrograde equipment to the contractor's facility at the government's expense"

The Government is still responsible for retrograde of equipment because "having the contractor cover the sheer number of sites and ships that would need to be covered on a daily basis would be financially infeasible" (G. D. Tonoff, personal communication, August 26, 2005).

H. EXIT PROVISIONS

The SOW (2000) provides that: "upon completion or termination of the contract, the contractor will transfer performance responsibility back to the government, while taking all precautions necessary to ensure that fleet readiness is not adversely impacted."

The SOW (2000) also requires, at no additional cost to the government, the following:

- Written current status for the following:
    - Quantity and condition of any Government Furnished Property (GFP) accountable to the Contractor to be returned during Phase III.
    - Quantity of Contractor Furnished Material (CFM) to be made available for Government purchase.
    - Format and configuration of technical and other Program data to be returned during Phase III.
    - Residual value of Government facilities resulting from Contractor improvements to be returned during Phase III.
- Return the Rotable Pool Equipment to the Government in RFI condition.

- Establish with the Government, a joint Exit Transition Integrated Process Team (IPT) to develop the schedule and milestones for an orderly transition of APU TLS to Government control.
- Deliver a proposal for procurement of all equipment repair piece parts required at all levels of maintenance. (SOW, 2000)

In summary, this chapter presented data specific to the Honeywell APU TLS PBL Contract, which will be analyzed in Chapter IV. The data presented included PBFR, Performance Metrics (availability and reliability), incentives, the gain share clause, and exit provisions. Additional data that was presented consisted of the actions, activities and accomplishments of the contract in pursuing the goals of PBL.

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IV. ANALYSIS

This chapter provides a qualitative and quantitative analysis of the data presented in Chapter III. This chapter seeks to determine if the contractual terms and conditions established were effective in facilitating the full potential of PBL savings and improved performance. In this chapter, we will analyze the metrics and incentives of the Honeywell TLS contract for their effectiveness in achieving the desired outcomes. Additionally, we will appraise the methods used in attaining the goals of PBL and provide information concerning the observed effects from the methods used. Lastly, we will provide alternative methods and measures, as appropriate.

A. AVAILABLE DATA

All aircraft types covered under this contract have been in operation for a significant period of time with associated operational and maintenance data readily available through NAVAIR's information systems such as the Naval Aviation Logistics Data Analysis (NALDA) database. Adequate data was available for establishing a meaningful baseline for ensuring the contract arrangements are cost effective.

B. CONTRACT

The ten-year requirements contract is an award-term arrangement and with successful performance, the contractor will be awarded five one-year additional periods. The contractor's incentive in meeting the availability and reliability performance metrics is to gain the award of the additional five one-year ordering periods. Basically, the contractor must meet the performance metrics to stay on contract. The award-term arrangement reduces the contractor's uncertainty and risk, because he knows that successful performance will lead to a longer-term contract. The longer-term contract allows the contractor to make investments in improving performance, reducing costs and recouping his initial outflows. On the other hand, shorter award-term arrangements, such as three base years and two one-year additional periods, may not allow the contractor enough time to complete the required investments in reliability and recover his initial losses. Additionally, the shorter period may not provide adequate compensation for the contractor assuming the huge risks associated with PBL.

In addition to the award-term arrangement, the contract provides for availability and reliability improvements over the life of the contract at a fixed price. The contract does not provide incentives for the contractor to provide greater availability above what is called for in the contract, but does provide penalties for availability rates below 90%. Additionally, there are no specific award fees or incentives tied to reliability improvements, but there are penalties for not meeting the APU Reliability Improvement Schedule. Basically, the contract buys availability and reliability improvements at a fixed price. According to DoD (2001) "incentives should be positive, but balanced". With this contract, the only positive incentive is the award-term arrangement. The negative incentives reduce the contractor's profit and ability to implement further reliability improvements causing a graveyard spiral, resulting in bad contract performance, contractor losses and unwillingness to accept the risks associated with PBL.

1. Price by Flight Hour Rates (PBFR)

Using PBFR to determine contract worth and basis of performance indicates that flight hours are important in explaining and forecasting APU unscheduled removals (MFHBUR). As shown in Appendix F, the covariance and coefficient of correlation between aircraft flight hours and the number of APU unscheduled removals indicates there is a weak positive linear relationship between aircraft flight hours and APU removals, except for the C-2, which demonstrates almost no correlation. In other words, as flight hours increase (slightly decrease for the C-2) so do the number of APU removals, but from the results of a regression analysis, the coefficient of determination (R^2) ranges from 0.0024 to 0.289. This means, at most, only 28.9% of the variation in APU unscheduled removals is accounted for by a linear relationship explained by flight hours. Additionally, the standard error to the average number of APU removals ranges from 27% to 93%, which indicates significant error between the actual value and the predicted value. Lastly, in testing the coefficient significance (flight hours) of the linear regression model, the null hypothesis is that the flight hour coefficient is not significant. In other words, flight hours do not affect the number of APU unscheduled removals. On the FA-18, S-3 and C-2, the P-values are not significant at any level and the t-statistic is within the rejection region, which means that we cannot reject the null hypothesis. Therefore, flight hours are not a good indicator of APU removals. For the P-3, the P-value is significant and the t-statistic is not in the rejection region, but with a standard error of 35% and a R^2 of 29%, flight hours are not the best indicator for P-3 APU unscheduled removals.

With the above, there is little or no relationship between aircraft flight hours and APU reliability and MFHBUR. Individual aircraft flights, an indicator of aircraft starts, provide similar results. The results infer that APU reliability has little impact on flight hours; therefore, MFHBUR is not an appropriate metric for TLS contract pricing and measuring APU reliability.

The results are validated after reviewing APU operations. The APU is rarely used in flight. The APU is primarily used for starting the aircraft engines before flight and for conducting ground maintenance. Aircraft flight hours do not account for the APU operational hours used during ground maintenance. As an example, the APU on the FA-18 and C-2 is used mainly for aircraft engine starts before flight or ground engine runs. The FA-18 APU operational use is generally three minutes for starting both engines as compared to an average 1.4 flight hours per flight, hence the R^2 of 0.0159. For the S-3, maintenance procedures require lengthy ground APU runs in addition to aircraft engine starts before flight. Therefore, the S-3 R^2 is higher than the FA-18 and C-2 R^2, but still a low value at 0.0482. A further validation of the above results is the contractor pursuing the installation of hour meters, start counters and or data memory buttons on the APU to accurately measure APU operational hours. .

An alternative to the PBFR contract pricing method follows. As stated, MFHBUR is not a good metric for measuring APU reliability. MFHBURs is used in the below calculations, because those are the values that are currently recorded. In establishing other PBL contracts for the APU or similar components, mean APU operational hours (minutes) between unscheduled removals or similar APU specific measure should be used.

For the C-2, the estimated average contract price is $888,500 with the assumption that the contract was properly valued at least including transaction fees, contract maintenance costs, risk, transportation requirements, spare parts inventory, storage, and Depot repairs. With the above assumption, we can demonstrate various price levels based on reliability improvements. For this demonstration, we will use only Depot repairs, but with improved reliability, cost for transportation, spare parts inventory, and storage would decrease.

To calculate the contract cost per MFHBUR and the estimated Depot repair costs, the average annual flight hours for the C-2 are approximately 8,700 flight hours and the baseline MFHBURs is 443 flight hours. The estimated contract cost of $888,500 equates to $2,005 per MFHBUR. Dividing the flight hours flown by the MFHBUR provides the expected number of depot repairs. In this case, the baseline expected depot repairs is twenty repairs per year. With a Depot repair price of $27,530, the twenty repairs equates to an annual cost of $550,600 The desired reliability improvement is 30% above the baseline, which equates to a MFHBUR of 576 flight hours. This improvement results in an expected fifteen annual depot repairs, which equates to a cost of $412,950 and a cost avoidance of $137,650. The new contract price at the desired reliability improvement would be $750,850 or $1,304 per MFHBUR. To achieve the desired reliability, by acting on the contractor's profit motive, the contract should be priced at or above the desired reliability improvement. In this case, the contract would be priced at or below $1,304 per MFHBUR. At this price level, the contractor would be motivated to decrease his current costs ($2,005 per MFHBUR) to the contract price (future costs) ($1,304 per MFHBUR) or below through reliability, supply chain and or process improvements. The contractor would break even and the government would achieve the desired reliability when the contractor reduces his costs (transportation requirements, spare parts inventory, storage, and Depot repairs) to $1,304 per MFHBUR or less. Any additional improvements by the contractor would lead to contractor profits and greater performance for the government.

With the above method, the true definition of PBL is achieved. Coupled with a long duration award term agreement, the contractor has the security and incentive to improve reliability and other processes to reduce his costs and generate a profit as soon as possible. Under this PBL arrangement, the contractor would be empowered to optimize system readiness and product support effectiveness to meet the specified performance metrics. If the contractor is unable to deliver reliability improvements, then the government still gains by paying less for logistics support than before the contract due to the negotiated lower price of the contract. The alternative pricing method provides incentives and empowerment to the contractor where the government gains the desired weapon system performance and the contractor is allowed his profits.

2. Performance Metrics

a. Availability

Availability as defined by the SOW (2000) equates to fill rate or parts availability, which, as defined by DoD (2004) and NAVAIR (2004b), is a logistics response time metric and not operational or inherent availability (A_o and A_i, respectively). Fill rate is a process measurement where an operational decision depends on that process information and is important, but this metric indicates that the APU mean time between maintenance (MTBM) and mean maintenance down time (MDT), elements of $A_{o,}$ can be any value as long as the contractor can provide (90% of the time) a replacement APU within the specified timeframes. On the other hand, under PBL, contracting for Ao can provide significant improvements in weapon system performance.

Ao is defined as: "the probability that a system or equipment, when used under stated conditions in an actual operational environment will operate satisfactorily when called upon (Blanchard, 1998). The formula for A_o is MTBM divided by the sum of MTBM and MDT (Blanchard, 1998). This formula shows the dynamic relationship between MTBM and MDT. Increasing the time between maintenance and reducing the maintenance down time can improve A_o. MDT includes active maintenance time, and logistics and administrative delay time. In contrast, fill rate includes logistics and administrative delay time, but does not include active maintenance time or MTBM.

Using A_o as a performance metric and with proper incentives, the contractor would be influenced to increase the APU's MTBM and reduce MDT. Conversely, by using fill rate as a performance metric, the contractor could be motivated to improve supply chain effectiveness, specifically transportation and distribution, rather than weapon system performance. To demonstrate this, the number of APU cannibalizations can be an indicator of supply chain effectiveness. If the numbers of cannibalizations decrease, then generally APUs are available for issue when required. With the inception of this contract, the number of cannibalizations shows a decreasing trend indicating improved supply chain effectiveness and parts availability.

The improved parts availability can also be attributed to the availability adjustment (penalty) for not meeting the contract requirement of 90% availability. "The availability adjustment was derived by dividing a total dollar amount by the number of percentage points to allocate the money over" (G. D. Tonoff, personal communication, August 26, 2005). The availability adjustment was not scientifically derived and may lead to excessive contractor penalties. The availability adjustment is provided for in increments of $20,000 per percentage point below 90%, but based on simple division; the availability percentage for the C-2 would be reduced by 4% per APU not delivered on time. Based on delivery records for FY04, twenty-five C-2 APUs were supplied to the war fighter. Using FY04 as the base year, shipping twenty-five APUs is 100% availability, while delivering twenty-four out of twenty-five equates to 96%, hence the 4% reduction per APU not delivered on time. Delivering one less APU, with average annual requisitions of twenty-five, represents a 4% change in availability. In this case, at twenty-two APUs (88% availability) the contractor would be penalized two percentage points ($40,000) and at twenty-one APUs (82%) the contractor would be penalized six percentage points ($120,000), based solely on the total number of requisitions (denominator). This excessive penalty appears to be an unintended consequence of not using rigorous methods to value penalties. Alternative methods are to penalize the contractor for each component not delivered within the specified timeframes, or preferably provide incentives to decrease logistics response time. The disincentive should cost the same or more than the cost of the service provided. From a basic online Federal Express rate quote, to ship a C-2 APU from the west coast to the east coast of the United States would generally cost from $1,700 to $2,300. So, the disincentive should be valued at or greater than $2,300 per APU not delivered within the required timeframe.

The preferred method would be to provide a monetary incentive for decreasing logistics delay time.

b. Reliability

As discussed in the analysis of PBFR, aircraft flight hours have little impact on APU reliability. MFHBUR, as defined in the contract, is therefore, an inappropriate measure of effectiveness for this application of PBL.

Additionally, the contractor has little or no control over unscheduled removals due to the APU not operating properly. The contractor would have to be involved with and influence government maintenance decisions such as O-level APU removal and I-level Beyond Capability Maintenance (BCM) actions. The number of BCM actions has increased dramatically, because of the transfer of first-degree and second-degree repair capability to the Depot and misinterpreting the TLS Contract as a warranty. All of the above increases the contractor's costs, motivating the contractor to provide training and troubleshooting to keep the APU installed. Additionally, maintenance processes can change. As in the case of the S-3, the aircraft inspection process was changed, requiring longer APU ground runs.

For reliability guarantees, the specified reliability improvement targets may be unrealistic. According to IG (2000), "the P-3 LECP would cost eight million dollars and require at least five years to deliver, install, and realize the reliability improvements". The TLS contract calls for a 300% improvement in the P-3 APU reliability in only two years. This effort would require significant resources to accomplish such an improvement in so short of a time. As of Sep 2004 (over three years under the TLS contract), the P-3 has experienced only a 9% to 17% increase in MFHBURs.

For the reliability adjustment, the amount appears to be simple division, a total dollar amount allocated over the four aircraft with the C-2 receiving proportionately less. The amount of the adjustment in comparison to the contract value ranges from 1.5% to 4.5% and maybe insignificant as a disincentive. Additionally, the P-3 LECP was estimated to cost $8 million dollars, whereas the penalty for not meeting the reliability guarantee is only $75,000. The contractor may be motivated to assume the least cost and may choose to not implement the reliability improvements. Additionally, the drafters of the contract "chose to put most of the money against delivery response time (availability) vice reliability as PBFR inherently incentives reliability" (G. D. Tonoff, personal communication, August 26, 2005). As discussed above, PBFR is not a good metric for providing incentives to APU reliability.

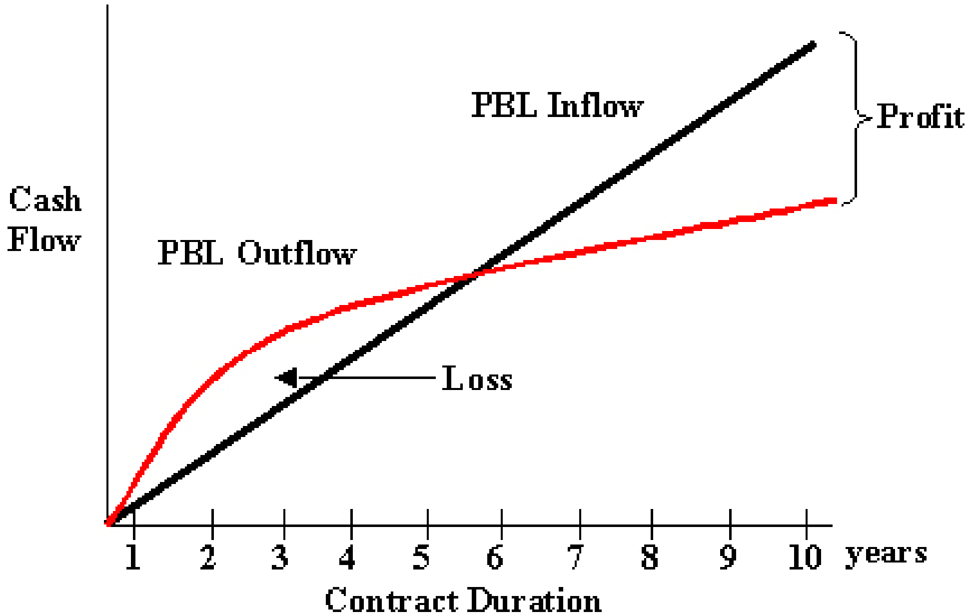

Figure 4. Contractor's PBL Cash Flow. (Kotlanger & Giuntini, 2004)

3. Gain Share

According to Kotlanger and Giuntini (2004), "a contractor with a PBL focus will place an emphasis on reducing the time required to make a profit". Additionally, Kotlanger and Giuntini (2004) stated that: "PBL offerings require large upfront investments (parts inventory, facilities, test equipment, etc.), with revenues often significantly trailing those expenditures. The contractor must attack these PBL outflows to make positive cash flow as soon as possible" (Kotlanger & Giuntini, 2004). Figure 4 demonstrates the contractor's time-to-profit emphasis discussed above. The graph does not use actual cost data and only identifies that losses can occur in the beginning of a PBL contract. The duration of the losses depends upon, among other things, the contractor's financial status, ability to manage cash flow, cost of required improvements and amount of cash inflow.

As defined in the contract, starting in year three of Phase II, the contractor is monetarily penalized for realizing reliability improvements greater than 25% above the guaranteed minimum improvement identified for each aircraft platform. According to Tonoff, "the gain share percentage of 25% was unscientific, but we recognized sharing from the first percentage or dollar of improvement wasn't logical. We allowed 25% improvement without sharing to encourage (reliability) investments" (G. D. Tonoff, personal communication, August 26, 2005). With this clause, the contractor has only two years to implement significant reliability and other logistics improvements without incurring the gain share clause. These tasks may be difficult given the initial capital investments of buying parts inventory and establishing the required logistics infrastructure. The gain share clause can be incurred when the contractor needs the cash most to recover from the initial capital investments. This penalty can restrict the contractor in actively reducing costs and achieving efficient and effective operations.

The above is demonstrated by gain share calculations and a basic cost to benefit comparison shown in Tables 5 and 6. Using the gain share formula described by Figure 2, Tables 5 and 6 identify the number of depot repairs and the Depot Repair Costs avoided with increasing reliability improvements. A Depot Repair Price of $27,530 (C-2 actual repair price) and an estimated shipping cost of $2,300 per APU shipped were used

Table 5. Gain Share Calculations

Baseline Repairs	24.9	11029	Actual FH
		443	Baseline MFHBUR
Reliability Guarantee	23.1	478	8% Improvement in MFHBUR
	1.8		Depot Repairs Avoided ($50,186)
	21.4	515	16% improvement in MFHBUR
	3.5		Depot Repairs Avoided ($95,822)
	20.1	549	24% improvement in MFHBUR
	4.8		Depot Repairs Avoided ($132,656)
	18.7	589	33% Improvement in MFHBUR
	6.2		
	$170,060		Depot Cost Avoided at 28% improvement
	$85,030		Government's Adjustment

Table 6. Cost Benefit Comparison			
Reliability Guarantee (8%)		**16% Reliability Improvement**	
Costs		**Costs**	
ECP Cost	$54,378	ECP Cost	$103,827
Gov Adj	$0	Gov Adj	$0
	$54,378		$103,827
Benefits		**Benefits**	
Repair Avoidance	$50,186	Repair Avoidance	$95,822
Shipping Avoidance	$4,193	Shipping Avoidance	$8,005
	$54,378		$103,827
24% Reliability Improvement		**33% Reliability Improvement**	
Costs		**Costs**	
ECP Cost	$143,789	ECP Cost	$99,237
Gov Adj	$0	Gov Adj	$85,030
	$143,789		$184,267
Benefits		**Benefits**	
Repair Avoidance	$132,656	Repair Avoidance	$170,060
Shipping Avoidance	$11,083	Shipping Avoidance	$14,208
	$143,789		$184,267

to complete these calculations. Using the 8%, 16%, 24% and 33% reliability improvement numbers, a basic cost to benefit comparison was made. The ECP cost for each comparison was adjusted so that the costs would equal the benefits. As shown in Table 6, the benefits of an 8% improvement in reliability include a shipping and repair cost avoidance of $54,378, which means the contractor can spend up to that amount on an ECP before incurring costs greater than the benefits. As shown in Table 6, the benefits and the funds available to conduct an engineering change increase as the percentage of improvement increases, except after the government's limitation of 25% above the guaranteed minimum improvement. At 33% (reliability guarantee plus 25%), the benefits are cost avoidances of $184,267, but the contractor incurs the gain share cost of $85,030, leaving only $99,237 for reliability improvements. At 33% improvement, the contractor will incur more costs than benefits and may be inclined to delay increasing the APU's performance. As defined in the contract, the gain share clause provides penalties rather than incentives and capped revenue at a critical time, which can delay improving the APU's reliability.

In addition to delaying reliability improvements, the gain share clause goes against the true definition of PBL where the contractor is allowed to maximize his profits by decreasing his costs through reliability improvements, supply chain efficiencies and other measures. Further, the contractor gain shares with the government by providing greater reliability (performance), while charging the government at a lower rate (i.e., 92% reliability at a rate for 90%). The government is risk adverse and is concerned that the contractor will gain too much profit or, in other words, the government will pay too much. To fully achieve the benefits of PBL, this mindset needs to change and recognize the contractor's profit motive. "The contractor's revenue does not have to increase, but there has to be a material improvement in profit through reliability improvements and reduced costs" (Kotlanger & Giuntini, 2005). Figure 4 indicates the contractor is making huge profits in the out-years, but the contractor's total profit should be equal to or greater than his losses. By allowing the contractor his profits, the government gains through improved weapon system performance and reduced operating costs.

C. COMPRESS THE SUPPLY THE CHAIN

There is no apparent compression of the DLR supply chain. The APU TLS contract with Honeywell features new supplier relationships and configurations, but the net result appears to be the addition of parallel processes and inventory. As shown in Appendix B, with the transfer of management of consumables in support of APU repairs, Honeywell duplicates some of DLA's functions. Additionally, the SOW (2000) requires Honeywell to ship RFI assets to the war fighter, which duplicates some of the duties of the DDD. With DLA no longer being the primary supplier of NADEP CP's APU consumables, the result is two parallel and duplicate inventories. These duplicate inventories and functions increase the complexity of the DLR supply chain and lead to cost inefficiencies, reduce the benefits of stock consolidation, and increase overhead costs.

D. ELIMINATE NON-VALUE ADDED STEPS

The indicators provided certainly suggest that non-value added steps were eliminated, but both parties, NADEP CP and Honeywell, implemented several initiatives before and during the period of the TLS contract that could have been responsible for the

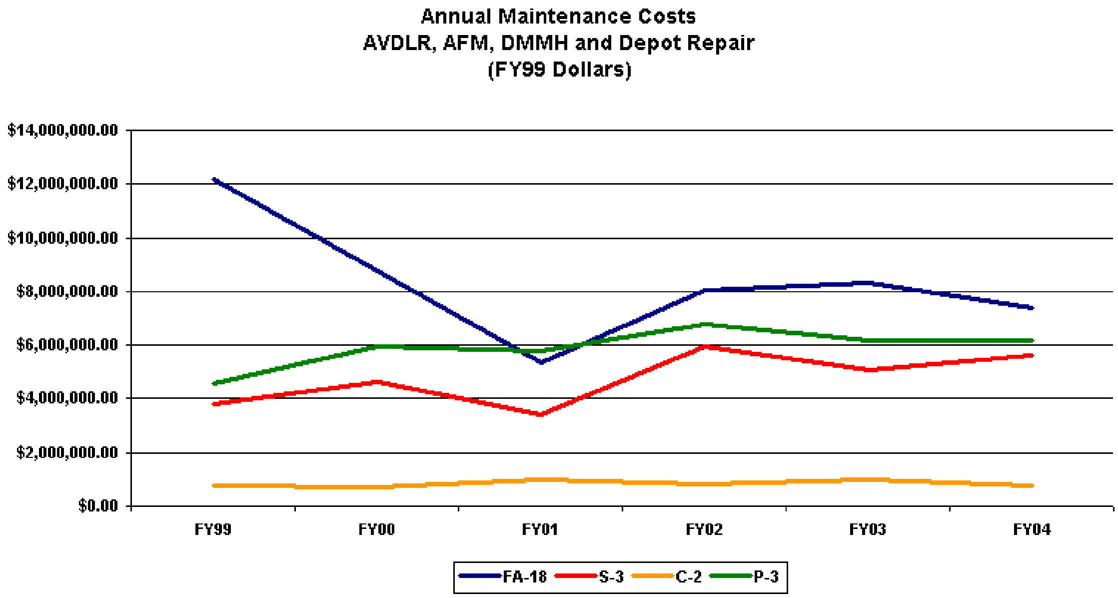

Figure 5. Aircraft Annual Maintenance Costs (FY99 dollars)

improvements in the process. Honeywell's initiatives under this contract did contribute to process improvements and the elimination of non-value added steps.

E. MAINTENANCE COST ELEMENTS

As shown in Figure 5, during FY01, all aircraft experienced a decrease in maintenance costs, except for the C-2. C-2 costs remained relatively the same from FY99 to FY04. From FY02 to FY04, all aircraft incurred greater costs as compared to FY01, except as noted for the C-2. Total costs increased for FY02, FY03, and FY04, because of the increased contract costs due to the increased flight hours associated with Operations Enduring Freedom (OEF) and Iraqi Freedom (OIF). The greater flight hours indicates a higher level of maintenance actions and greater overall costs. Overall, during the indicated period, C-2 costs remained the same; F-18 costs are less than original costs; and P-3 and S-3 costs increased.

For the C-2, costs remained relatively the same from FY99 to FY04. AVDLR and Depot costs increased, while AFM and DMMH costs decreased. The increase in AVDLR and Depot costs can be attributed to an increase in the number of BCMs with an associated decrease in the use of consumable items at the I-level due to transferring first and second degree repair to the Depot. Additionally, during FY01 and FY02, the C-2's flight hours were increased as compared to FY00. During FY02, FY03 and FY04, nearly all APU maintenance actions at the I-level resulted in BCMs. Additionally, there has not been any apparent increase in the reliability of the C-2 APU. The bottom line for the C-2 is that average yearly costs after the APU TLS contract have increased 16% as compared to the average yearly costs prior to the contract. The increase in average yearly costs can be attributed to increased flight hours during FY01 and FY02, a nearly doubled BCM rate and no reliability improvements.

For the FA-18, total costs decreased during FY01, but then increased over the next three years. AVDLR costs decreased during FY01, due to the change in Net Price, although there was an increase in items processed. AVDLR costs during FY02, FY03 and FY04 increased because of greater usage (OEF/OIF operations), which created higher contract costs than AVDLR charges. Additionally, there was relatively no change in AFM, DMMH or Depot repair costs, except during FY02 and FY03 when a greater level of flight hours was incurred. The bottom line for the FA-18 is that average yearly costs after the APU TLS contract have decreased by 31% as compared to the average yearly costs prior to the contract. The decrease in average yearly costs can be attributed mainly to the decrease in the APU's Net Price. FA-18 APU removals have not decreased (no reliability improvements) and the BCM rate has not increased similar to other aircraft.

For the P-3, total costs slightly decreased during FY01, increased during FY02, decreased during FY03, while remaining flat for FY04. Overall, AFM costs have significantly decreased, while Depot costs have increased 100% or more. AVDLR and DMMH costs have relatively remained the same. The increase in depot costs is not accounted for by the P-3 BCM rate, which only increased by 3%. Based on the data collected, the exact reason for Depot costs to increase is difficult to identify, but may be attributed to the age of the aircraft, and design limitations in reliability and maintainability. The slight decrease in costs during FY01 can be attributed to the P-3 having the lowest reduction in Net Price offset by a slight increase in flight hours. During FY02, FY03, and FY04, the P-3 experienced an increase in flight hours overall and specifically, per airframe. In other words, each aircraft is flying more hours, which leads to greater costs. The decrease in costs from FY02 to FY03 and FY04 can be attributed to the achieved reliability improvements resulting in a decrease in the number of APU removals. The bottom line for the P-3 is that average yearly costs after the APU TLS contract have increased 18% as compared to the average yearly costs prior to the contract. The increase in average yearly costs can be attributed mainly to the doubling of Depot repair costs.

For the S-3, total costs decreased during FY01, but then increased during FY02, FY03 and FY04. Total costs during FY01 decreased mainly because of the significant decrease in APU net price. AVDLR costs during FY01 decreased significantly with the significant decrease in APU net price. Total costs increased for FY02 and FY03, because of the increased contract costs associated with increased flight hours during OEF and OIF. AFM costs decreased tremendously throughout the period, while AVDLR and Depot Repair costs increased due to increased BCMs and flight hours during OEF and OIF. Contract costs exceeded AVDLR costs during OEF and OIF due to PBFR. DMMH costs increased dramatically during FY02 indicating the increased workload supporting the S-3 in a deployed environment and the lack of reliability improvements. During FY03 and FY04, DMMH decreased approaching normal levels. The bottom line for the S-3 is that average yearly costs after the APU TLS contract have increased 19% as compared to the average yearly costs prior to the contract. The increase in average yearly costs can be attributed mainly to the increased contract costs during OEF and OIF, an increase in BCMs (97% BCM Rate during FY04) and associated AVDLR and Depot Repair Costs.

F. APU PERFORMANCE

1. Availability

Parts availability has increased with Average Delivery Time reduced from 35 days to 5.4 days, 98% requisitions filled and supply material availability from 65% to 95% (Sara & Garvey, 2004), but IG (2000) "contends that FY 1999 availability for the majority of the repairable items was 90% or better, with the four APUs being 87% available". Additionally, "Honeywell manufactures the additional part that has caused the delays in repairs of five items with low availability" (IG, 2000). IG (2000) questioned "how Honeywell can improve their production schedule to meet TLS contract demands while they were not improved to meet DLA demands". According to Tonoff (2000);

> DLA's practice is to order material from Honeywell at manufacturing lead time and with a DLA administrative lead time of more than 180 days large quantity orders are placed for several years worth of demand. This practice often results in significant backorders for the material at the time of the order. Under TLS, Honeywell will place small quantity orders at production lead time at a demand equal to actual consumption plus safety stock to meet demand surges. Delivery will be just in time at a rate that is well within production capacity (Tonoff, 2000).

2. Reliability

As discussed in the analysis of Price by Flight Hour Rates, flight hours are not a good metric for determining APU reliability. As shown in Appendix E, the P-3 reliability has improved. The FA-18, C-2 and S-3 reliability has generally remained the same or not improved.

G. LOGISTICS FOOTPRINT

1. Reliability Improvements and Cannibalizations

Improving reliability increases the probability that the APU will continue to operate over a longer period of time. Greater reliability, along with decreased cannibalizations, means a smaller logistics footprint, including time and money required, fewer people, less maintenance actions and reduced inventory and spares. Cannibalizations have decreased, because of increased availability of spares, but only one aircraft has demonstrated reliability improvements. The MFHBUR for the other aircraft have not improved, indicating that the same or more removals are still being conducted; therefore, no reduction in footprint.

2. Staffing Levels, Inventory and Equipment Needs, and Facilities

As discussed, the change to the maintenance plan transfers first-degree and second-degree repair from the I-level to the D-level. The implication of a reduction in repair capability is the potential for reduction in staffing levels, inventory and equipment needs, and facilities at the I-level, but the savings may not be realized.

For staffing levels, a Power Plants Mechanic is responsible for maintaining both the aircraft engine and the APU. With this arrangement, there would be a reduction in workload, but not necessarily staffing at the war fighter level. At the upper levels of staffing, IG (2000) indicates that there is no evidence of eliminating any layers of management, and appears that there are actually additional layers of management. The additional layers of management include the dedicated PCO and WSM, and the establishment of the CSB for this contract. The PCO and WSM are in addition to existing PMs and the CSB is in addition to all the other boards and meetings that encompasses a PM's day.

Table 7. Equipment Reduction Percentages

Category	Equipment
P-3 Shop Equipment	72%
P-3 Test Cell	41%
C-2 Shop Equipment	48%
C-2 Test Cell	5%
S-3 Shop Equipment	42%
S-3 Land based Test Cell	10%
S-3 Shipboard Test Cell	0%
FA-18 Shop Equipment	20%
FA-18 Land based Test Cell	0%
FA-18 Shipboard Test Cell	0%

For inventory and equipment needs, additional tools, test equipment, and maintenance fixtures and stands are required to conduct first-degree and second-degree maintenance over third-degree repairs. By eliminating first-degree and second-degree repair at the I-level, the potential for reduction in assets is shown in Table 7. The equipment reduction percentages were calculated by counting the total equipment required for I-level repair capability. Dividing the first-degree and second-degree repair equipment by the total equipment furnished the percentage of equipment reduction. The list of tools required for APU repair actions is reduced an average 24%, but sometimes the gear is not transferred out of the unit or is used for other maintenance actions resulting in limited reduction of logistics footprint.

For facilities, third-degree repair entails test and check operations requiring test cells and other equipment. Therefore, hangar bays, work centers and test cells remain in support of APU third-degree repair actions and other type model series engines and aircraft. There can be a savings in facilities, but these freed up assets (work centers, test cells, etc.) would be quickly absorbed into other maintenance operations negating any savings.

3. Training

TECOM (2002) and NAVPERS (2004) not being updated is an indication that training at an MOS/NEC granting school has also not been updated, providing no apparent reduction in training requirements. Additional training by the contractor is allowed by the SOW (2000) and is implied by the contractor’s motivation to conduct the informal field maintenance and operations training to reduce unwarranted removals at the O-level and increase repairs at the I-level. Reducing removals at the O-level increases the APU’s time on wing and apparent MFHBUR, while increasing repairs at the I-level decreases BCM actions and reduces the contractor’s cost in D-level repairs. The contractor’s FSE add to the list of contractor representatives already crowding the hangar decks and maintenance facilities.

4. Publications

The Program Offices, in conjunction with NATEC, are still responsible for maintaining, printing, distributing, and updating technical publications for other aircraft systems and the O-level portion of the APU system; therefore, only marginal savings in logistics footprint have been achieved in this area.

5. Transportation Assets

The government is responsible for NRFI shipments, while the contractor is responsible for RFI shipments. Government transportation assets are still required providing only a minimal reduction in footprint.

H. EXIT PROVISIONS

Exit Provisions are adequate and mitigate long-term risk by facilitating the re-establishment of organic or commercial support capability.

In summary, this chapter provided a qualitative and quantitative analysis of the data presented in Chapter III. The analysis included determining the effectiveness of the metrics and incentives of the Honeywell TLS contract and an appraisal of the methods used in attaining the goals of PBL. Lastly, alternative methods and measures were provided, as appropriate.

V. CONCLUSIONS AND RECOMMENDATIONS

In this chapter, the findings of our research will be summarized. Recommendations specific to the Honeywell APU TLS PBL contract and PBL applications in general will be provided.

A. CONCLUSIONS

1. Contract

The contract meets best commercial practices by applying PBL at the component level where appropriate system performance data was available to establish cost effective contract arrangements.

The contract is not a true PBL application in that the contract buys availability and reliability improvements at a fixed price with required improvement schedules. The contract does not provide positive incentives for the contractor to provide greater reliability, but rather specific reliability improvement deliverables. Penalties are assessed for not meeting the APU Reliability Improvement Schedule and availability rates below 90%.

The most important incentive of this contract is the ten-year award term arrangement. The ten-year award term arrangement reduces the contractor's uncertainty and risk, because he knows that successful performance will lead to a longer-term contract. The longer-term contract allows the contractor to make investments in improving performance, reducing costs and recouping his initial outflows. On the other hand, shorter award-term arrangements, such as three base years and two one-year additional periods, may not allow the contractor enough time to complete the required investments in reliability and recover his initial investments.

a. Price by Flight Hours (PBFR)

Flight hours have little impact on APU reliability; therefore, PBFR and MFHBUR is not an appropriate metric for TLS contract pricing and measuring APU reliability. In a simple linear regression analysis, the model involving flight hours as an indicator of APU unscheduled removals was found to be invalid. At most, only 28.9% of the variation (R^2) in APU unscheduled removals is explained by flight hours. The results were validated, because the APU is rarely used in flight. The APU is primarily used for starting the aircraft engines before flight and for conducting ground maintenance. Aircraft flight hours do not account for the APU operational hours used during ground maintenance. Aircraft flight hours are not a good indicator of APU removals and for tracking reliability improvements.

With the operation of the APU being independent of flight hours, the APU could be considered a weapon system in itself, with its own subcomponents and metrics including availability (A_o), reliability, Cost per Usage, logistics footprint and logistics response time. The APU is an ideal candidate for the contractor to be solely responsible for the operational availability of the APU.

The alternative pricing method discussed, achieves the true definition of PBL. The alternative pricing method sets the contract price at the desired reliability improvement by accounting for reduced Depot repairs, transportation, spares inventory, and storage requirements. Under this pricing method, the contractor would be empowered to optimize system readiness and product support effectiveness to meet the specified performance metrics. Coupled with a long duration award term agreement, the contractor has the security and incentive to improve reliability and other processes to reduce his costs and generate a profit as soon as possible. If the contractor is unable to deliver reliability improvements, then the government still gains by paying less for logistics support than before the contract due to the negotiated lower price of the contract. The alternative pricing method provides incentives, empowerment and profits to the contractor and the government gains the desired weapon system performance and cost savings.

b. Availability

Availability as defined by the SOW (2000) equates to a Logistics Response Time (LRT) metric, and is an important metric in that an operational decision depends on that process information. The problem with this metric by itself is that MTBM and MDT of the APU can be any value as long as the contractor can provide (90% of the time) a replacement APU within the specified timeframes. On the other hand, significant improvements in weapon system performance can be obtained by contracting for A_o and LRT. With proper incentives, the contractor would be motivated to increase the APU's MTBM and reduce MDT, which leads to the reduction of parts requisitions, inventory, cycle time and overall costs.

The availability adjustment was apparently not analytically determined and can result in excessive penalties. The availability adjustment is provided for in increments of $20,000 per percentage point below 90%, but based on simple division and using FY04 data; the availability percentage for the C-2 would be reduced by 4% per APU not delivered on time. In this case, at twenty-two APUs (88% availability) the contractor would be penalized two percentage points ($40,000) versus a shipping cost of only $2,300. Alternative methods are to penalize the contractor for each component not delivered within the specified timeframes, or preferably provide incentives to decrease logistics response time.

c. Reliability

APU reliability (MFHBUR) is independent of Aircraft flight hours; therefore, an inappropriate measure of effectiveness for tracking reliability improvements. Additionally the contractor has little or no control over unscheduled removals, which can result in unwarranted removals, reduced MFHBUR, and contractor incurred penalties.

The contract reliability guarantees are unrealistic. IG (2000) stated that the P-3 LECP would require up to five years to deliver components and realize the benefits. "The P-3 LECP is based on upgrading 175, 95-3 and 35, 95-2 P-3 APUs to a 95-10 configuration" (IG, 2000). Under the TLS contract, the specified reliability improvement target for the P-3 is 300% improvement in two years, with actual improvements only being 9% to 17% in over three years.

The reliability adjustment was apparently not analytically determined and may be insignificant when compared to the value of the contract, and costs required for reliability improvements. The contractor may be motivated to assume the least cost and may choose not to implement the reliability improvements.

d. Gain Share Clause

The Gain Share Clause is an attempt at sharing the benefits gained, but the timing is poor and goes against the true definition of PBL. The true definition of PBL allows the contractor to maximize his profits by decreasing his costs through reliability improvements, supply chain efficiencies and other measures. Further, the contractor gain shares with the government by providing greater reliability (performance), while charging the government at a lower rate (i.e., 92% reliability at a rate for 90%). The gain share clause, as written, can be incurred when the contractor needs the cash most to recover from the initial capital investments in purchasing inventory and equipment, and conducting reliability improvements. As defined in the contract, the gain share clause provides penalties rather than incentives and capped revenue at a critical time, which can delay improving the APU's reliability. By allowing the contractor his profits, the government gains through improved weapon system performance and reduced operating costs.

2. Compress the Supply Chain

There is no apparent compression of the DLR supply chain. The APU TLS contract with Honeywell features new supplier relationships and configurations, but the net result appears to be the addition of parallel processes and duplicate inventories. Honeywell conducts the same DLA functions with the transfer and management of APU specific consumables to Honeywell. Honeywell via CatLog also performs the duties of the DDD with storing and shipping APU components. DLA and DDD still exist and provide for other DoD customers. These parallel processes and duplicate inventories increase the complexity of the DLR supply chain and lead to cost inefficiencies, reduce the benefits of stock consolidation, and increase overhead costs.

3. Eliminate Non-value Added Steps

Non-value added steps were eliminated, but both parties, NADEP CP and Honeywell, implemented several initiatives before and during the period of the TLS contract that could have been responsible for the improvements in the process.

4. Maintenance Cost Elements (in 1999 dollars)

Overall, during the FY99 to FY04 period, C-2 costs remained the same; F-18 costs are less than original costs; and P-3 and S-3 costs increased. Significant events that impacted costs included the drop in the AVDLR Net Price during FY01 and surge operations associated with Operations Enduring Freedom (OEF) and Iraqi Freedom (OIF) during FY02, FY03, and FY04. The greater flight hours during OEF and OIF generated higher contract costs due to PBFR and more maintenance actions; therefore, greater overall costs. Another significant event was the changes to the maintenance plan, which transferred first-degree and second-degree repair capability to the D-level. This change caused AVDLR and Depot costs to rise, and AFM and DMMH costs to fall, due to an increasing BCM rate at the I-level.

The bottom line for individual aircraft follows:

- C-2 average yearly costs were up 16% due to greater flight hours during FY01 and FY02, a nearly doubled BCM rate and no reliability improvements.
- FA-18 average yearly costs declined 31% due to the decrease in the APU's Net Price. FA-18 APU removals have not diminished (no reliability improvements) and the BCM rate has not risen similar to other aircraft.
- P-3 average yearly costs rose 18% due to Depot repair costs climbing 100% or more. The P-3 experienced reliability improvements for the APU, but the increased Depot costs and flight hours offset the benefits of the improvements.
- S-3 average yearly costs grew 19% due to the higher contract costs during OEF and OIF, and significant growth in BCMs (97% BCM Rate during FY04) and associated AVDLR and Depot Repair Costs.

5. APU Performance

a. Availability

Parts availability has increased with Average Delivery Time reduced from 35 days to 5.4 days, 98% requisitions filled and supply material availability from 65% to 95% (Sara & Garvey, 2004).

b. Reliability

Improved reliability is difficult to ascertain with any certainty, because MFHBUR is not a good metric for determining APU reliability. The analysis conducted suggests the following results:

- The P-3 reliability has improved.
- The FA-18, C-2, and S-3 reliability has generally remained the same or not improved.

6. Logistics Footprint

With no reliability improvements; unrealized savings in manpower, equipment, facilities and training; and only partial reductions in publications and transportation assets the logistics footprint has only been marginally reduced. Only one aircraft type has demonstrated reliability improvements, while the MFHBUR for the other aircraft types have not improved. This indicates that the same or more removals are still being conducted; therefore, no change in footprint. For manpower, the result is a reduction in workload at the I-level, but not actual personnel. Additionally, there is an actual increase in duties and responsibilities at the PM level. The list of tools required for APU repair actions is reduced an average of 24%, but sometimes the gear is not transferred out of the unit or used for other maintenance actions resulting in limited savings. There can be a savings in facilities, but these freed up assets (work centers, test cells, etc.) would be quickly absorbed into other maintenance operations negating any savings. For training, there is no apparent reduction in training requirements, which means the same level of training is still being conducted. Also, the contractor's FSE add to the list of contractor representatives already crowding the hangar decks and maintenance facilities. For publications, the Program Offices are still responsible for the technical publications for other aircraft systems and the O-level portion of the APU system; therefore, only marginal savings in logistics footprint have been achieved in this area. Government transportation is still required for shipping NRFI assets to the contractor's facility; thereby, providing only a minimal reduction in footprint. Overall, there is very little reduction in the logistics footprint.

B. RECOMMENDATIONS

1. Honeywell TLS APU Contract

Contract for TLS of the APU as an end item. The contractor would be solely responsible for the operational availability and reliability of the APU. The contract would be a ten-year, fixed price, award term contract using the alternative pricing method discussed. Contract pricing would be based solely on price by Mean APU Hours between Unscheduled Removals (MHBUR). Contract metrics would include Operational Availability, MHBUR (APU), Logistics Response Time and cost. The contractor would be responsible for providing APUs and other components to the flight line. Measures to control APU removals would have to be negotiated and established to avoid unwarranted removals, reduced MHBUR, and contractor-incurred penalties. Organic O-level personnel, in consultation with contractor FSEs and other negotiated procedures, would remove and replace the APU and other external APU components. There would be no organic I-level APU repair capability. The contractor would be empowered to improve system readiness and logistics support across the integrated logistics support elements for the APU.

Specific recommendations include:

- Use alternative pricing method, including Price by APU Operational Hours, that facilitates the true definition of PBL for achieving reliability improvements.
- Install hour meters, start counters and or data memory buttons to accurately record APU usage.
- After installing APU hour meters and start counters, change PBFR to Price by APU MHBUR, to provide an incentive to increase APU reliability.

- Rename availability to parts availability or fill rate and maintain the logistics response time metric as currently defined in the SOW (2000).
- Change availability adjustment to price per component not delivered on time or preferably employ incentives for reducing logistics response time.
- Change reliability metric, MFHBUR, to Mean APU Hours Between Unscheduled Removals (MHBUR).
- Eliminate the gain share clause and use the alternative pricing method, which provides incentives, empowerment and profits to the contractor and improved weapon system performance and cost savings to the government.
- Conduct a comprehensive cost benefit study to identify actual cost savings/avoidances and benefits obtained versus the original business case analysis, as discussed in GAO (2005), related to the APU TLS PBL contract.
- Update TECOM (2002) and NAVPERS (2004) and associated training requirements and then reduce or eliminate training at the MOS/NEC granting school.

2. Other PBL Applications

Use long duration award term contracts with at least a five-year base and five, one-year additional periods for PBL applications. The longer time duration reduces the contractor's uncertainty and risk, and provides enough time for the contractor to make investments in improving performance, reducing costs and recouping his initial outflows.

Conduct analysis to determine appropriate alternative pricing method to achieve reliability improvements rather than specified guarantees or negative incentives. Reliability guarantees and disincentives are not required with the alternative pricing method, because the contractor will accelerate reliability and other process improvements to make a profit as soon as possible.

Conduct analysis to determine proper timing and other terms for establishing gain share measures that reflect the true definition of PBL and the contractor's profit motive.

In compressing the supply chain, employ initiatives that completely transfer, rather than replicate, processes from organic support to commercial practices, with no residual organic processes remaining. Approaches that minimally compress the supply chain result in fragmented efforts, duplicated processes, and a more complex supply chain with numerous logistics support providers. Partnerships and contract arrangements should consolidate effort, and avoid parallel processes and duplicate inventories.

To identify non-value added steps that were eliminated, specifically document direct links to savings (as a result of PBL partnership) and quantify improvements. In conjunction with the aforementioned cost benefit analysis, continue to monitor processes and document realized savings and efficiencies to build a more comprehensive body of knowledge (data) for analysis.

For reducing the logistics footprint, implement a more comprehensive approach to execution. All ILS elements should be reviewed to identify impacts and required changes or adjustments. A plan of action should address the required changes for complete implementation to fully realize reductions in logistics footprint.

C. CLOSING

In closing, our findings indicate that non-value added steps were eliminated, and there were potential reductions in the logistics footprint, but the supply chain was not compressed and aircraft maintenance costs did not decrease. More importantly, the APU reliability for the FA-18, S-3, and C-2 did not improve. For the P-3, reliability improved by 7% to 19%, but not 300% per the contract guarantee. Our research also determined that the reliability metric was inappropriate for measuring and tracking APU reliability improvements. Additionally, disincentives were provided for not meeting contract requirements with the only contract incentive being the award term contract arrangement. Our report provided recommendations specific to the APU TLS contract and other recommendations for other PBL applications. These recommendations include an alternative contract pricing and gain sharing methods and appropriate metrics and incentives that reflect the true definition of PBL.

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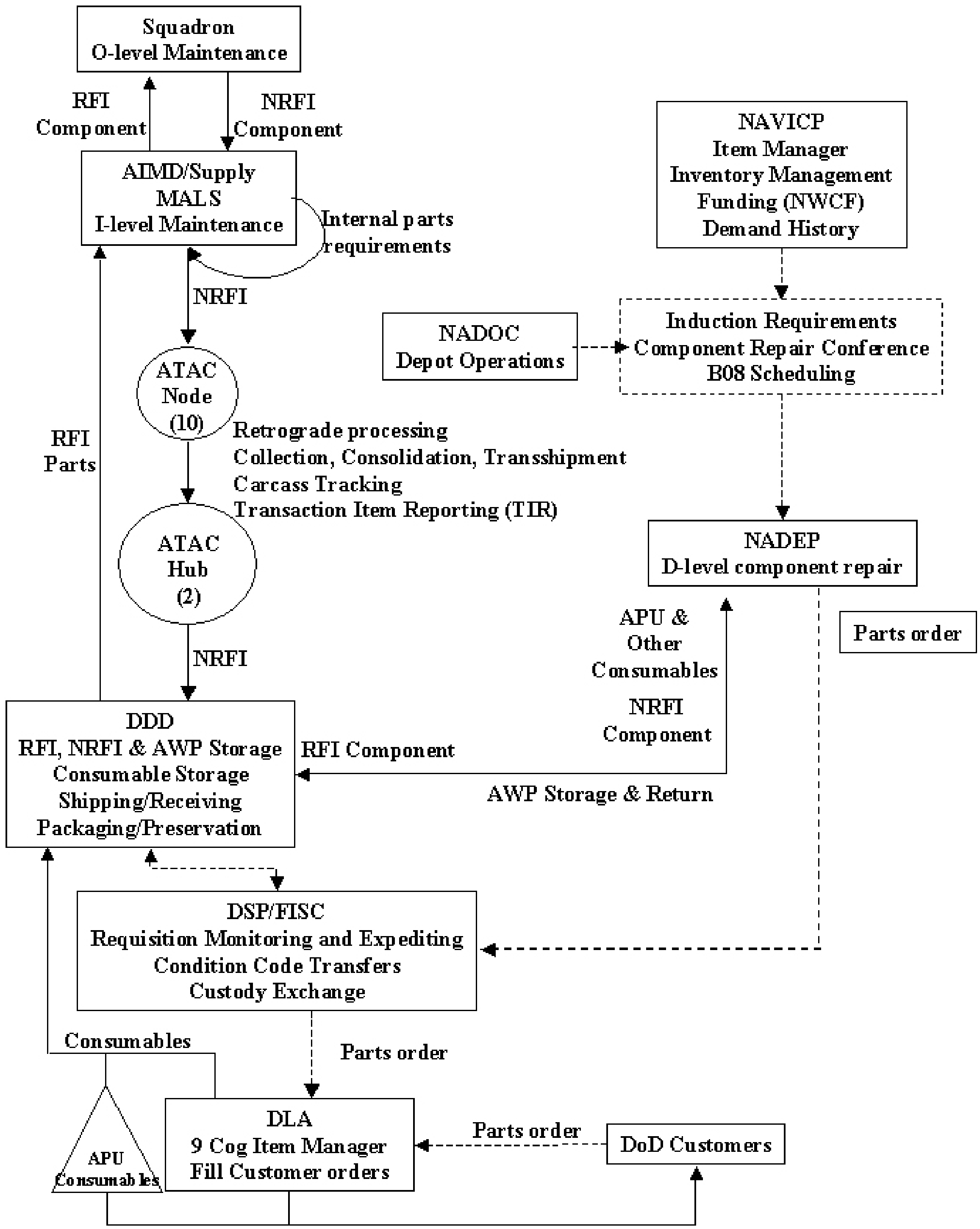
APPENDIX A. SUPPLY CHAIN BEFORE TLS CONTRACT



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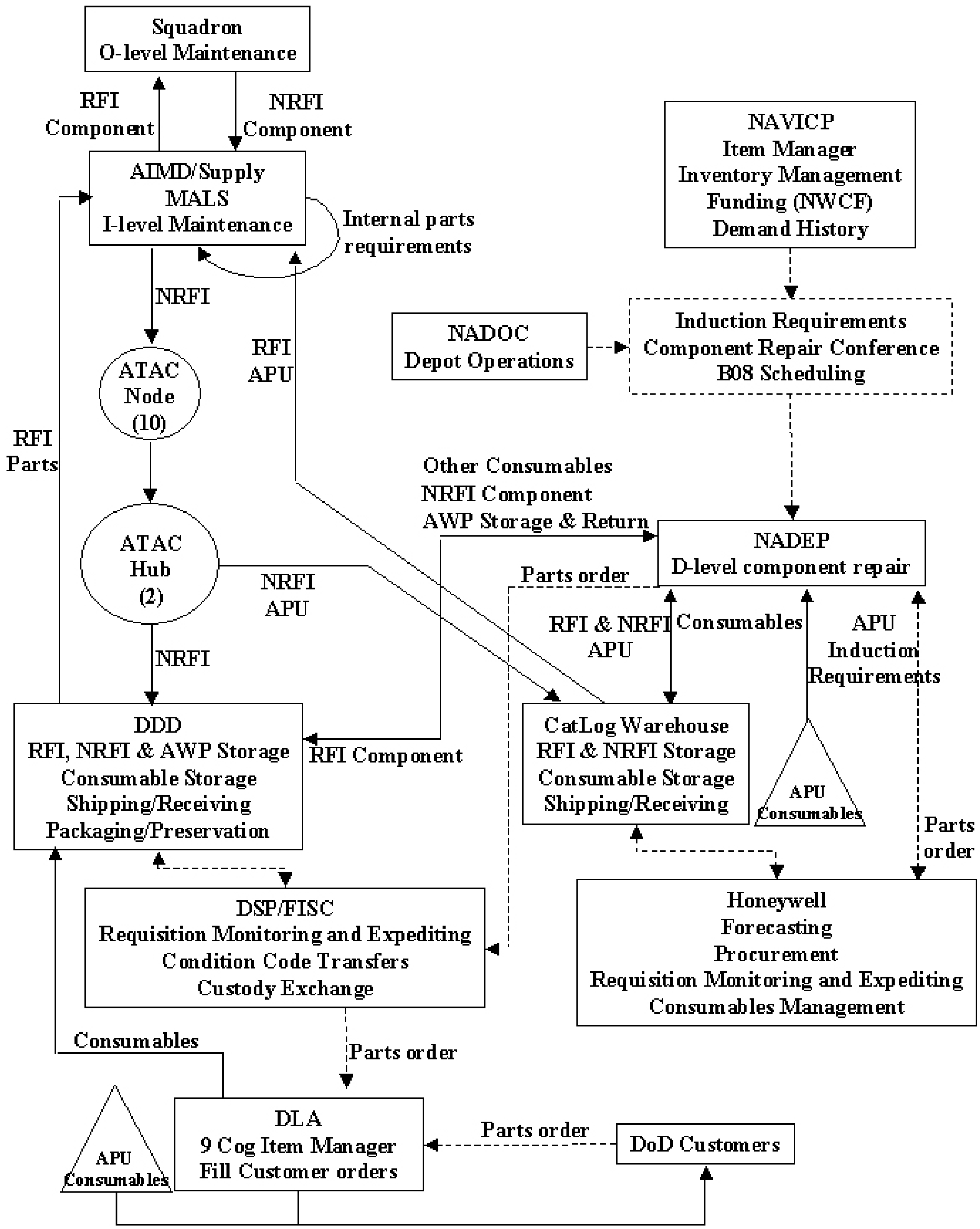
APPENDIX B. SUPPLY CHAIN AFTER TLS CONTRACT



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APPENDIX C. MAINTENANCE COST DATA (FY99 DOLLARS)

P-3	AVDLR	AFM	DMMH	Depot	Estimated Contract Cost	Total Costs
FY99	$3,515,080.00	$128,912.00	$549,266.00	$381,112.00	$0.00	$4,574,370.00
FY00	$4,770,074.95	$261,061.14	$649,188.36	$295,254.86	$0.00	$5,983,846.45
FY01	$4,504,802.87	$190,744.94	$491,229.29	$577,728.00	$2,634,972.94	$5,796,800.10
FY02	$5,480,534.39	$38,640.69	$536,784.15	$739,823.14	$4,986,658.38	$6,859,111.23
FY03	$3,454,528.87	$47,135.60	$591,750.05	$934,361.17	$4,614,405.37	$6,288,096.02
FY04	$5,084,965.33	$40,610.26	$489,138.23	$531,178.86	$3,237,571.20	$6,216,698.82

C-2	AVDLR	AFM	DMMH	Depot	Estimated Contract Cost	Total Costs
FY99	$590,170.00	$14,313.00	$98,545.00	$90,943.00	$0.00	$793,971.00
FY00	$611,893.49	$685.40	$43,493.10	$80,340.47	$0.00	$736,412.46
FY01	$721,007.46	$6,564.95	$42,126.32	$208,580.36	$383,721.56	$978,279.09
FY02	$613,228.23	$2,048.96	$43,302.53	$76,077.75	$697,236.80	$818,666.03
FY03	$829,085.95	$1,558.21	$36,230.96	$99,431.15	$581,902.91	$966,306.27
FY04	$655,475.73	$2,271.84	$11,321.31	$121,459.45	$567,570.30	$790,528.33

S-3	AVDLR	AFM	DMMH	Depot	Estimated Contract Cost	Total Costs
FY99	$3,167,590.00	$112,533.00	$65,933.00	$452,852.00	$0.00	$3,798,908.00
FY00	$4,147,475.35	$1,219.92	$57,064.10	$408,513.62	$0.00	$4,614,272.99
FY01	$2,783,900.03	$109,907.97	$46,204.59	$453,841.27	$2,542,582.17	$3,393,853.86
FY02	$2,467,708.13	$10,509.62	$562,872.93	$631,870.85	$4,730,600.59	$5,935,853.99
FY03	$3,728,623.28	$2,657.51	$210,057.36	$677,278.56	$4,172,272.21	$5,062,265.63
FY04	$4,760,270.92	$3,441.52	$95,024.50	$763,912.47	$3,339,677.40	$5,622,649.41

FA-18	AVDLR	AFM	DMMH	Depot	Estimated Contract Cost	Total Costs
FY99	$9,255,840.00	$438,707.00	$1,000,012.00	$1,511,037.00	$0.00	$12,205,596.00
FY00	$6,548,323.47	$386,367.85	$744,844.18	$1,082,676.07	$0.00	$8,762,211.57
FY01	$3,327,317.64	$379,670.64	$703,452.48	$933,997.54	$3,059,604.59	$5,344,438.30
FY02	$3,035,806.82	$463,793.10	$832,833.87	$1,038,125.46	$5,736,666.36	$8,071,418.79
FY03	$5,266,470.75	$655,006.58	$889,518.53	$1,097,582.84	$5,671,907.03	$8,314,014.99
FY04	$5,269,438.74	$349,109.57	$688,805.36	$939,539.40	$5,392,206.82	$7,369,661.15

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APPENDIX D. APU PERFORMANCE DATA

P-3 DATA

DATE	FLTS TOT	FHRS TOT	REMS	CANNS	MFHBUR	MFLTSBUR
1998/10	2,185	9,864	27	0	365.3	80.9
1998/11	1,908	8,047	27	0	298.0	70.7
1998/12	1,798	8,295	19	0	436.6	94.6
1999/01	1,862	8,229	30	0	274.3	62.1
1999/02	2,006	9,327	23	0	405.5	87.2
1999/03	2,372	11,039	26	0	424.6	91.2
1999/04	2,170	10,345	31	0	333.7	70.0
1999/05	2,043	9,415	25	0	376.6	81.7
1999/06	2,125	10,340	30	1	344.7	70.8
1999/07	1,810	7,921	34	0	233.0	53.2
1999/08	1,970	8,796	29	0	303.3	67.9
1999/09	2,004	8,899	23	0	386.9	87.1
1999/10	2,021	9,026	27	0	334.3	74.9
1999/11	1,781	7,760	27	0	287.4	66.0
1999/12	1,724	6,944	11	0	631.3	156.7
2000/01	1,766	7,221	20	0	361.1	88.3
2000/02	1,906	8,182	28	0	292.2	68.1
2000/03	2,204	9,605	27	0	355.7	81.6
2000/04	2,020	8,766	31	0	282.8	65.2
2000/05	2,084	9,248	44	0	210.2	47.4
2000/06	2,151	9,923	42	0	236.3	51.2
2000/07	1,889	8,238	24	0	343.3	78.7
2000/08	1,910	8,221	39	0	210.8	49.0
2000/09	1,823	8,240	42	1	196.2	43.4
2000/10	2,050	9,293	46	1	202.0	44.6
2000/11	1,879	8,328	34	0	244.9	55.3
2000/12	1,509	7,139	14	1	509.9	107.8
2001/01	1,880	8,261	29	1	284.9	64.8
2001/02	1,889	8,560	29	0	295.2	65.1
2001/03	2,060	9,114	29	0	314.3	71.0
2001/04	2,200	9,332	28	0	333.3	78.6

2001/05	2,068	9,311	38	0	245.0	54.4
2001/06	1,783	8,281	19	1	435.8	93.8
2001/07	1,864	8,450	26	0	325.0	71.7
2001/08	2,064	9,321	43	1	216.8	48.0
2001/09	1,887	9,124	44	1	207.4	42.9
2001/10	2,048	9,766	48	0	203.5	42.7
2001/11	2,012	9,567	25	1	382.7	80.5
2001/12	1,952	9,444	37	0	255.2	52.8
2002/01	2,089	10,469	38	0	275.5	55.0
2002/02	1,997	9,902	40	1	247.6	49.9
2002/03	2,148	10,649	28	1	380.3	76.7
2002/04	2,241	10,361	33	0	314.0	67.9
2002/05	2,262	10,896	42	0	259.4	53.9
2002/06	1,850	8,752	34	0	257.4	54.4
2002/07	2,061	9,964	50	0	199.3	41.2
2002/08	2,063	10,056	24	0	419.0	86.0
2002/09	2,035	9,467	44	1	215.2	46.3
2002/10	2,138	10,111	31	0	326.2	69.0
2002/11	1,865	8,881	11	1	807.4	169.5
2002/12	1,598	7,597	15	1	506.5	106.5
2003/01	1,903	8,495	17	0	499.7	111.9
2003/02	1,999	9,322	11	3	847.5	181.7
2003/03	1,913	9,213	14	0	658.1	136.6
2003/04	2,230	11,197	22	0	509.0	101.4
2003/05	2,092	9,388	16	0	586.8	130.8
2003/06	1,901	8,719	16	0	544.9	118.8
2003/07	1,995	8,889	17	1	522.9	117.4
2003/08	1,813	8,594	14	0	613.9	129.5
2003/09	1,961	9,049	14	0	646.4	140.1
2003/10	1,891	8,157	16	0	509.8	118.2
2003/11	1,536	6,711	28	0	239.7	54.9
2003/12	1,375	6,014	14	0	429.6	98.2
2004/01	1,407	5,672	13	0	436.3	108.2
2004/02	1,462	6,151	6	0	1025.2	243.7
2004/03	1,549	6,408	12	0	534.0	129.1
2004/04	1,551	6,334	29	0	218.4	53.5
2004/05	1,412	5,982	10	0	598.2	141.2
2004/06	1,475	6,212	16	0	388.3	92.2
2004/07	1,529	6,253	9	0	694.8	169.9

2004/08	1,534	6,377	15	0	425.1	102.3
2004/09	1,563	6,313	17	0	371.4	91.9

C-2 DATA

DATE	FLTS TOT	FHRS TOT	REMS	CANNS	MFHBUR	MFLTSBUR
1998/10	533	1,020	1	0	1020.0	533.0
1998/11	552	1,041	2	0	520.5	276.0
1998/12	287	546	3	0	182.0	95.7
1999/01	283	624	3	0	208.0	94.3
1999/02	384	754	2	0	377.0	192.0
1999/03	524	910	2	2	455.0	262.0
1999/04	522	965	1	0	965.0	522.0
1999/05	520	905	0	0	905.0	905.0
1999/06	644	1,140	1	0	1140.0	644.0
1999/07	571	1,023	0	0	1023.0	1023.0
1999/08	337	722	2	0	361.0	168.5
1999/09	373	783	5	0	156.6	74.6
1999/10	452	912	2	0	456.0	226.0
1999/11	352	666	2	0	333.0	176.0
1999/12	326	623	2	0	311.5	163.0
2000/01	292	581	0	0	581.0	581.0
2000/02	402	761	1	0	761.0	402.0
2000/03	572	971	1	0	971.0	572.0
2000/04	414	689	2	0	344.5	207.0
2000/05	567	1,007	4	0	251.8	141.8
2000/06	476	898	3	0	299.3	158.7
2000/07	231	475	1	1	475.0	231.0
2000/08	299	649	0	0	649.0	649.0
2000/09	442	739	0	0	739.0	739.0
2000/10	647	1,157	2	0	578.5	323.5
2000/11	470	827	0	0	827.0	827.0
2000/12	359	702	2	0	351.0	179.5
2001/01	360	734	2	0	367.0	180.0
2001/02	507	856	0	0	856.0	856.0
2001/03	460	834	1	0	834.0	460.0
2001/04	426	926	1	0	926.0	426.0
2001/05	430	839	1	0	839.0	430.0
2001/06	527	951	0	0	951.0	951.0
2001/07	441	817	1	0	817.0	441.0
2001/08	411	799	2	0	399.5	205.5
2001/09	454	894	5	0	178.8	90.8

2001/10	445	1,012	1	0	1012.0	445.0
2001/11	458	1,001	2	0	500.5	229.0
2001/12	318	722	1	0	722.0	318.0
2002/01	378	952	2	0	476.0	189.0
2002/02	450	1,028	2	0	514.0	225.0
2002/03	433	869	1	0	869.0	433.0
2002/04	472	1,041	0	0	1041.0	1041.0
2002/05	502	1,014	3	0	338.0	167.3
2002/06	382	764	1	0	764.0	382.0
2002/07	449	868	1	0	868.0	449.0
2002/08	447	914	2	0	457.0	223.5
2002/09	397	844	0	0	844.0	844.0
2002/10	361	676	0	0	676.0	676.0
2002/11	441	744	3	0	248.0	147.0
2002/12	382	719	4	0	179.8	95.5
2003/01	545	887	2	0	443.5	272.5
2003/02	521	880	0	0	880.0	880.0
2003/03	507	733	4	0	183.3	126.8
2003/04	443	722	0	0	722.0	722.0
2003/05	342	596	4	0	149.0	85.5
2003/06	440	871	0	0	871.0	871.0
2003/07	335	744	0	0	744.0	744.0
2003/08	375	827	2	1	413.5	187.5
2003/09	350	728	0	0	728.0	728.0
2003/10	362	744	2	0	372.0	181.0
2003/11	330	646	1	0	646.0	330.0
2003/12	288	589	1	0	589.0	288.0
2004/01	305	586	3	0	195.3	101.7
2004/02	404	758	0	0	758.0	758.0
2004/03	456	869	1	0	869.0	456.0
2004/04	426	830	1	0	830.0	426.0
2004/05	360	663	1	0	663.0	360.0
2004/06	485	846	1	0	846.0	485.0
2004/07	528	858	1	0	858.0	528.0
2004/08	374	721	0	0	721.0	721.0
2004/09	433	767	0	0	767.0	767.0

S-3 DATA

DATE	FLTS TOT	FHRS TOT	REMS	CANNS	MFHBUR	MFLTSBUR
1998/10	1,819	3,862	8	0	482.8	227.4
1998/11	1,867	4,015	10	0	401.5	186.7
1998/12	1,324	3,044	22	0	138.4	60.2
1999/01	1,407	3,000	19	1	157.9	74.1
1999/02	1,851	4,177	7	2	596.7	264.4
1999/03	2,320	4,821	16	2	301.3	145.0
1999/04	1,645	3,374	14	0	241.0	117.5
1999/05	1,802	3,976	13	0	305.8	138.6
1999/06	1,940	4,228	13	0	325.2	149.2
1999/07	2,042	4,408	13	0	339.1	157.1
1999/08	2,011	4,156	18	1	230.9	111.7
1999/09	1,241	2,589	18	1	143.8	68.9
1999/10	1,947	4,170	18	2	231.7	108.2
1999/11	1,816	3,652	15	0	243.5	121.1
1999/12	1,250	2,754	12	1	229.5	104.2
2000/01	1,551	3,065	13	0	235.8	119.3
2000/02	1,510	3,023	13	0	232.5	116.2
2000/03	1,972	4,316	12	1	359.7	164.3
2000/04	1,559	3,229	12	0	269.1	129.9
2000/05	1,930	4,246	15	0	283.1	128.7
2000/06	1,505	3,317	12	0	276.4	125.4
2000/07	1,314	2,561	22	0	116.4	59.7
2000/08	1,633	3,256	9	1	361.8	181.4
2000/09	1,637	3,217	23	0	139.9	71.2
2000/10	2,220	4,481	15	1	298.7	148.0
2000/11	1,646	3,209	12	1	267.4	137.2
2000/12	1,095	2,220	11	1	201.8	99.5
2001/01	1,458	2,729	17	0	160.5	85.8
2001/02	1,590	2,783	14	0	198.8	113.6
2001/03	1,907	3,825	12	0	318.8	158.9
2001/04	1,803	3,328	11	0	302.5	163.9
2001/05	1,966	3,633	13	0	279.5	151.2
2001/06	1,738	3,423	5	0	684.6	347.6
2001/07	1,665	2,940	14	0	210.0	118.9
2001/08	1,744	3,574	19	0	188.1	91.8
2001/09	1,738	3,190	8	0	398.8	217.3
2001/10	2,396	4,938	7	0	705.4	342.3
2001/11	2,164	4,409	14	0	314.9	154.6
2001/12	1,660	3,334	11	0	303.1	150.9
2002/01	2,095	3,921	11	0	356.5	190.5

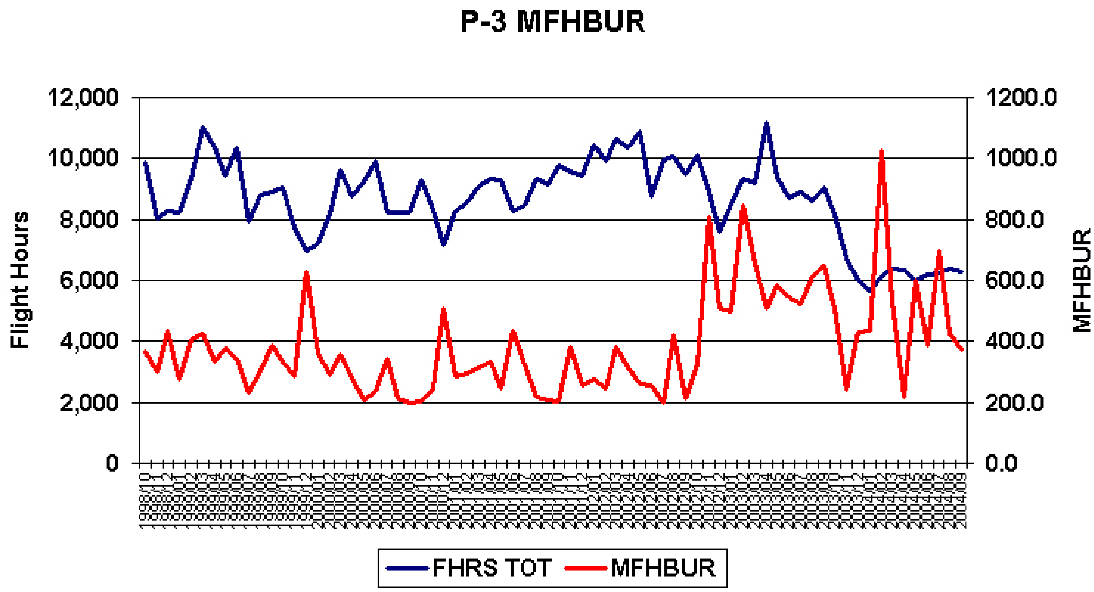
2002/02	1,655	3,323	7	0	474.7	236.4
2002/03	1,993	3,869	11	0	351.7	181.2
2002/04	2,041	4,443	21	0	211.6	97.2
2002/05	1,658	3,551	6	0	591.8	276.3
2002/06	1,518	3,087	7	0	441.0	216.9
2002/07	1,754	3,529	10	0	352.9	175.4
2002/08	1,440	2,741	7	0	391.6	205.7
2002/09	1,714	3,415	5	0	683.0	342.8
2002/10	1,948	3,493	12	0	291.1	162.3
2002/11	1,796	3,534	16	0	220.9	112.3
2002/12	1,115	2,020	4	0	505.0	278.8
2003/01	2,056	3,916	10	0	391.6	205.6
2003/02	1,705	3,306	4	0	826.5	426.3
2003/03	2,869	5,533	2	0	2766.5	1434.5
2003/04	2,274	4,655	8	0	581.9	284.3
2003/05	1,102	2,166	5	0	433.2	220.4
2003/06	1,261	2,400	10	0	240.0	126.1
2003/07	1,346	2,703	10	0	270.3	134.6
2003/08	1,374	2,441	6	0	406.8	229.0
2003/09	1,422	2,804	8	0	350.5	177.8
2003/10	1,280	2,345	12	0	195.4	106.7
2003/11	1,437	2,947	8	0	368.4	179.6
2003/12	1,032	2,040	4	0	510.0	258.0
2004/01	1,502	2,598	5	0	519.6	300.4
2004/02	1,219	2,104	6	0	350.7	203.2
2004/03	1,504	3,090	5	0	618.0	300.8
2004/04	1,374	2,854	7	0	407.7	196.3
2004/05	1,278	2,391	5	0	478.2	255.6
2004/06	1,870	3,263	6	0	543.8	311.7
2004/07	1,085	2,437	4	0	609.3	271.3
2004/08	1,295	2,561	4	0	640.3	323.8
2004/09	1,272	2,475	4	0	618.8	318.0

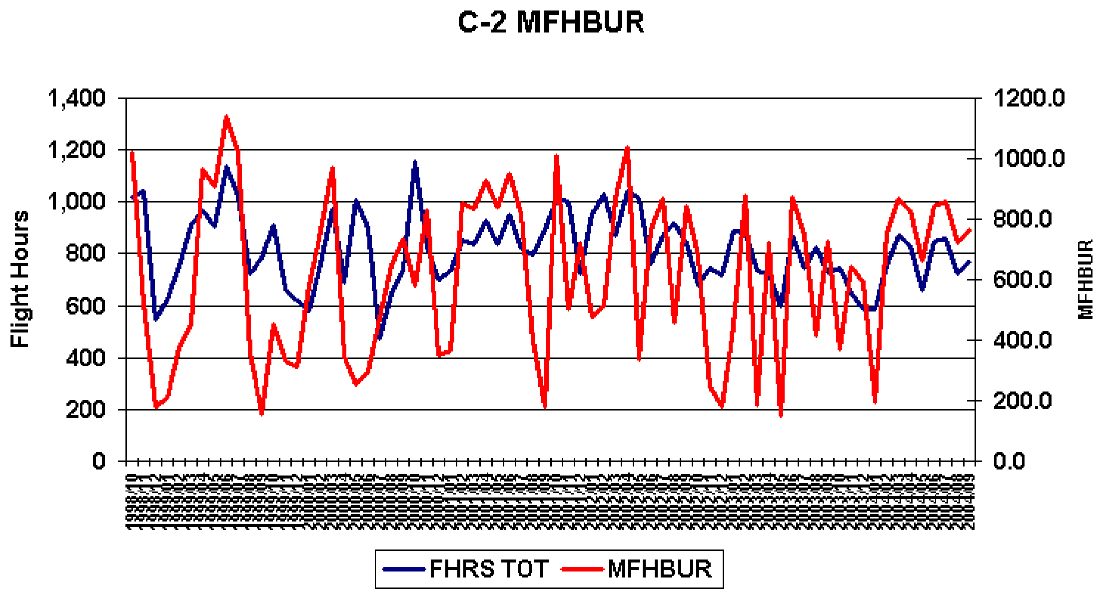
FA-18 DATA

DATE	FLTS TOT	FHRS TOT	REMS	CANNS	MFHBUR	MFLTSBUR
1998/10	15,239	20,869	14	1	1490.6	1088.5
1998/11	12,372	17,147	27	0	635.1	458.2
1998/12	10,110	14,272	18	0	792.9	561.7
1999/01	12,933	18,526	29	0	638.8	446.0
1999/02	15,072	21,332	27	2	790.1	558.2
1999/03	16,006	22,898	21	0	1090.4	762.2
1999/04	12,816	17,839	23	0	775.6	557.2
1999/05	14,351	20,452	30	1	681.7	478.4
1999/06	13,731	19,767	28	0	706.0	490.4
1999/07	13,177	19,448	23	1	845.6	572.9
1999/08	12,439	17,651	33	2	534.9	376.9
1999/09	12,199	17,562	22	1	798.3	554.5
1999/10	12,716	17,497	13	1	1345.9	978.2
1999/11	12,207	17,516	28	1	625.6	436.0
1999/12	10,235	14,346	17	0	843.9	602.1
2000/01	12,119	17,147	30	0	571.6	404.0
2000/02	13,317	18,802	35	1	537.2	380.5
2000/03	14,134	20,217	18	0	1123.2	785.2
2000/04	13,607	18,720	28	0	668.6	486.0
2000/05	15,299	21,031	12	1	1752.6	1274.9
2000/06	13,314	18,884	29	1	651.2	459.1
2000/07	12,405	17,109	24	0	712.9	516.9
2000/08	14,887	20,725	35	0	592.1	425.3
2000/09	13,350	18,861	30	0	628.7	445.0
2000/10	14,554	20,440	27	0	757.0	539.0
2000/11	12,228	16,905	37	1	456.9	330.5
2000/12	10,171	14,492	14	1	1035.1	726.5
2001/01	12,697	17,856	37	1	482.6	343.2
2001/02	13,283	18,692	30	0	623.1	442.8
2001/03	14,678	20,899	26	0	803.8	564.5
2001/04	13,492	18,811	41	1	458.8	329.1
2001/05	15,118	20,510	32	0	640.9	472.4
2001/06	13,895	20,428	20	0	1021.4	694.8
2001/07	14,089	19,559	25	0	782.4	563.6
2001/08	15,358	21,609	27	1	800.3	568.8
2001/09	12,762	17,857	31	1	576.0	411.7
2001/10	14,223	23,211	32	2	725.3	444.5
2001/11	12,324	22,327	36	1	620.2	342.3
2001/12	11,402	20,325	24	1	846.9	475.1
2002/01	14,420	23,089	35	0	659.7	412.0

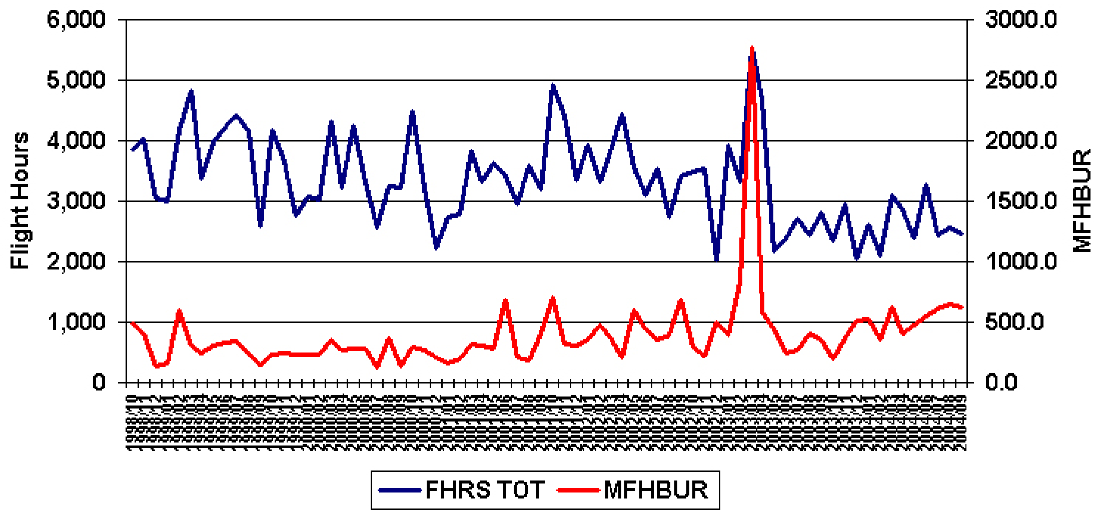
2002/02	13,118	20,017	20	0	1000.9	655.9
2002/03	13,667	20,600	47	1	438.3	290.8
2002/04	15,386	23,285	22	0	1058.4	699.4
2002/05	14,912	22,170	31	1	715.2	481.0
2002/06	13,473	19,823	33	2	600.7	408.3
2002/07	15,032	22,899	33	3	693.9	455.5
2002/08	15,470	23,090	42	0	549.8	368.3
2002/09	14,411	21,384	24	1	891.0	600.5
2002/10	15,689	21,345	33	0	646.8	475.4
2002/11	13,610	19,879	41	1	484.9	332.0
2002/12	11,002	15,034	32	1	469.8	343.8
2003/01	15,059	21,634	34	0	636.3	442.9
2003/02	13,435	20,341	25	0	813.6	537.4
2003/03	17,219	28,719	30	0	957.3	574.0
2003/04	16,261	31,637	23	0	1375.5	707.0
2003/05	11,326	17,573	28	0	627.6	404.5
2003/06	14,346	20,751	47	0	441.5	305.2
2003/07	13,671	20,017	35	2	571.9	390.6
2003/08	14,152	19,201	22	0	872.8	643.3
2003/09	14,873	20,997	31	0	677.3	479.8
2003/10	13,890	18,289	25	0	731.6	555.6
2003/11	12,261	17,750	20	0	887.5	613.1
2003/12	12,286	17,015	28	0	607.7	438.8
2004/01	13,371	18,686	21	0	889.8	636.7
2004/02	14,503	20,191	36	1	560.9	402.9
2004/03	17,165	24,676	30	0	822.5	572.2
2004/04	15,215	21,337	24	0	889.0	634.0
2004/05	13,886	19,267	16	2	1204.2	867.9
2004/06	15,494	22,727	23	0	988.1	673.7
2004/07	12,665	19,277	27	0	714.0	469.1
2004/08	15,464	22,441	20	1	1122.1	773.2
2004/09	14,301	22,101	17	1	1300.1	841.2

APPENDIX E. MFHBUR CHARTS

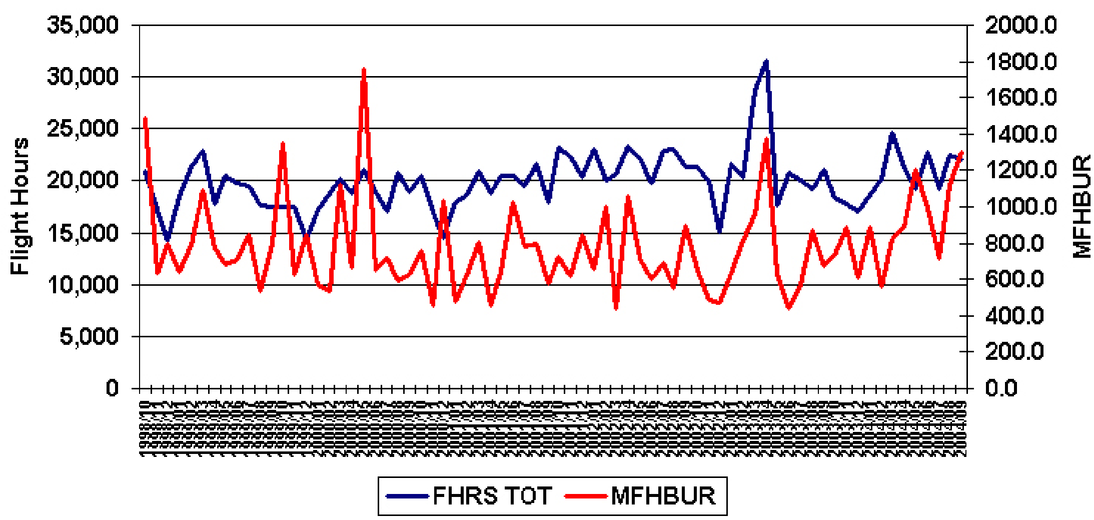




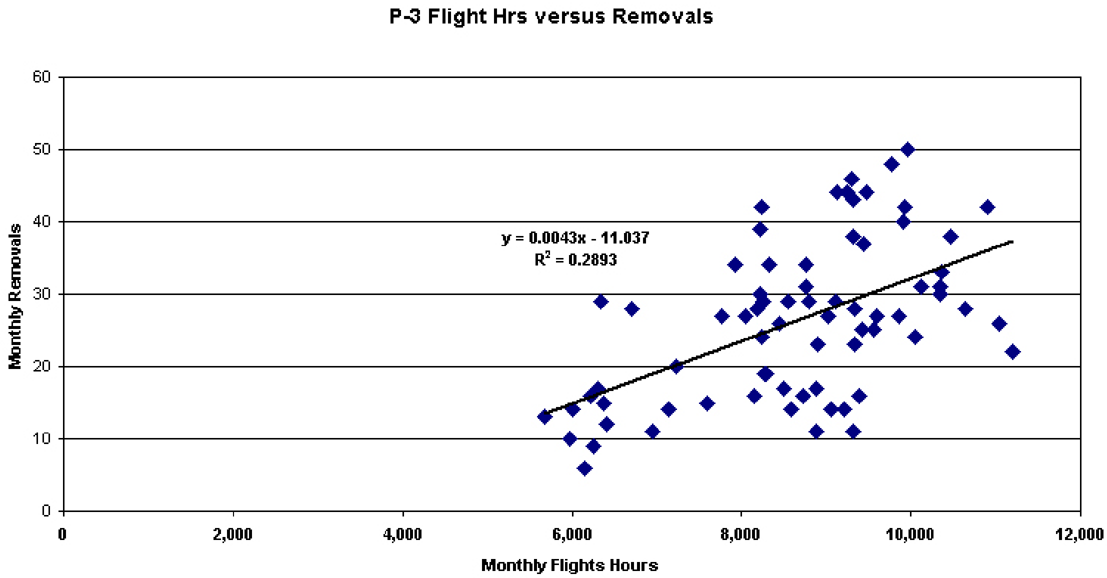
S-3 MFHBUR

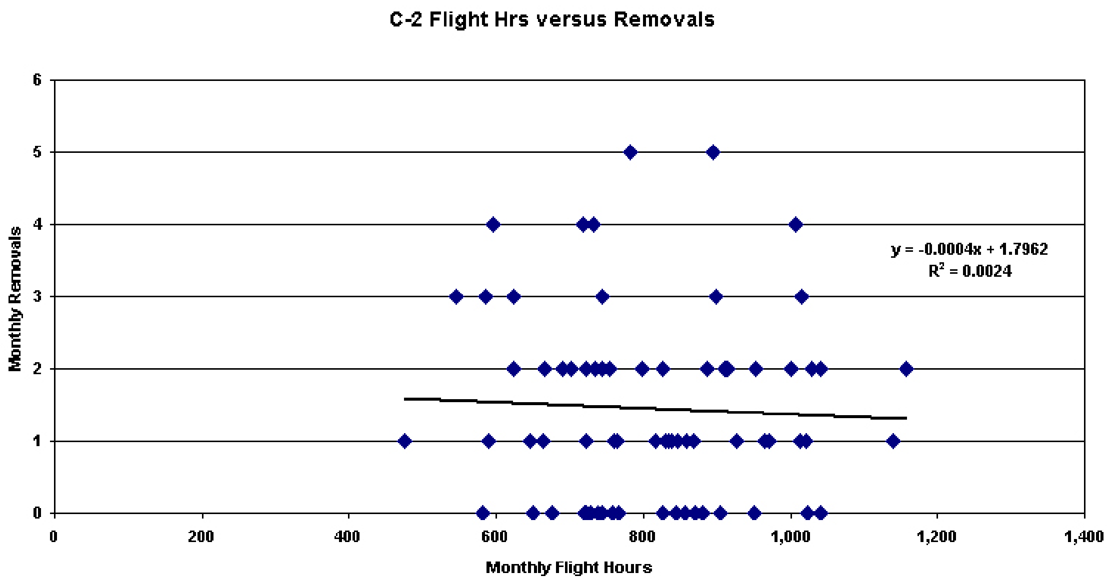


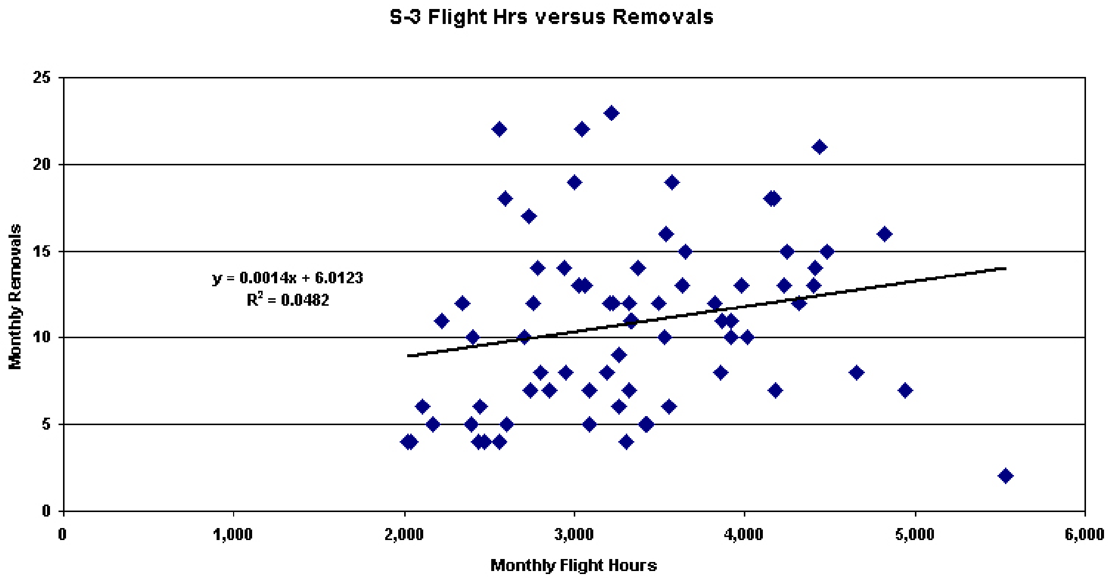
FA-18 MFHBUR

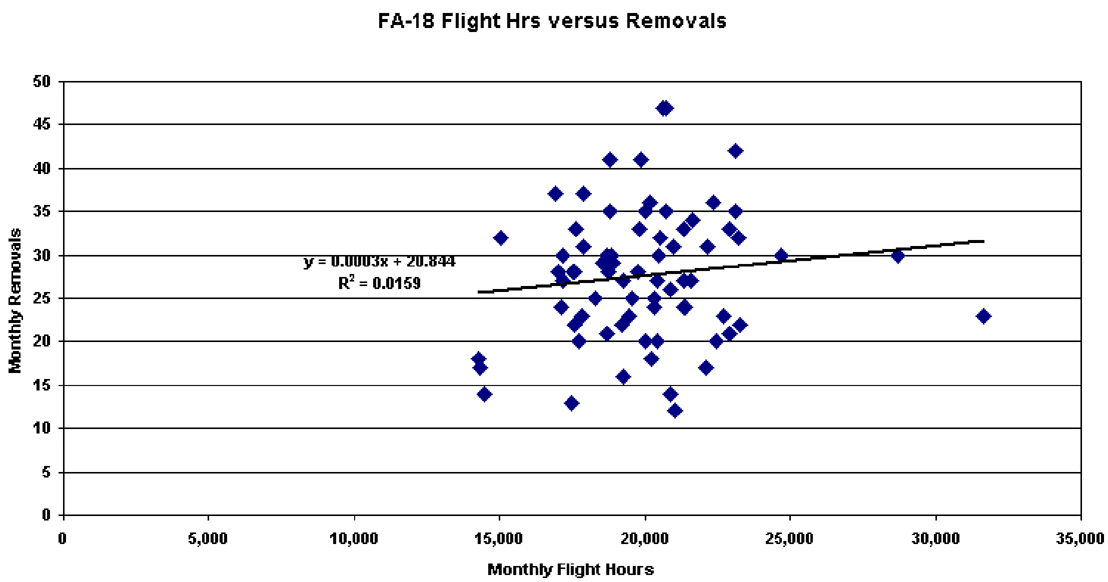


APPENDIX F. MFHBUR XY SCATTER DIAGRAMS






S-3 Flight Hrs versus Removals
y = 0.0014x + 6.0123
R² = 0.0482
Monthly Removals
Monthly Flight Hours
0
5
10
15
20
25
0
1,000
2,000
3,000
4,000
5,000
6,000


FA-18 Flight Hrs versus Removals
y = 0.0003x + 20.844
R² = 0.0159
Monthly Removals
Monthly Flight Hours
0
5
10
15
20
25
30
35
40
45
50
0
5,000
10,000
15,000
20,000
25,000
30,000
35,000

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