

**Evaluation of
Performance Based Logistics**
by
Jacques S. Gansler and William Lucyshyn



**CENTER FOR PUBLIC POLICY
AND PRIVATE ENTERPRISE**

SCHOOL OF PUBLIC POLICY

August 2006
This research was sponsored by
Naval Postgraduate School

THIS PAGE INTENTIONALLY LEFT BLANK

Table of Contents

Table of Contents	ii
List of Figures	iii
I. The DoD Imperative for Performance Based Logistics.....	1
A. DoD Logistics	1
B. Why DoD Cannot Get Performance Based Results with Traditional Logistics Support.....	5
C. PBL is the DoD’s Preferred Product Support Strategy.....	5
D. PBL Attributes	7
E. Organization of the Report	10
II. PBL support for the F/A-18	11
A. Background	11
B. F/A-18 Sustainment Strategy	12
C. Contract Details.....	14
D. Program Performance	19
III. Aircraft Tires.....	23
A. Background	23
B. Contract Details.....	23
C. Performance	25
IV. A-RCI and Virginia S/CC/A.....	27
A. Background	27
B. Program Description	28
C. Program Operation	31
D. Performance Metrics	33
E. Future Outlook.....	34
V. Findings and Conclusions	36
A. DoD Must Move to a World Class System.....	36
B. Barriers to Implementation.....	36
C. PBL Implementation Enablers	40
E. Conclusion.....	43
Reference List	44
Acknowledgments.....	46
About the Authors.....	47

List of Figures

Figure 1. Logistics Results: “Successful,” but not World-Class	2
Figure 2. DoD performance compared to commercial firms	4
Figure 3. Spectrum of PBL Strategies	6
Figure 4. Summary of PBL Guidance.....	8
Figure 5. Sustainment Organization Source	13
Figure 6. Migration to a Single FIRST Firm Fixed Price Contract	16
Figure 7. F/A Awarded and Pending PBLs by Subsystem.....	17
Figure 8. Hornet Readiness Status	20
Figure 9. “FIRST” Stabilizes the Cost of F/A-18 E/F Spares and Repairs	21
Figure 10. PBL Availability Successes.....	22
Figure 11. Program Structure.....	24
Figure 12. Tire Performance	25
Figure 13. Tire Inventory	26
Figure 14. Supply Availability.....	33
Figure 15. Average Customer Wait Time.....	34
Figure 16. MFOP Pilot Program Final Results.....	35

I. The DoD Imperative for Performance Based Logistics

"Good logistics is combat power"

LtGen. William G. Pagonis
Dir of Logistics during the Gulf War of 1991

A. DoD Logistics

The *National Defense Strategy of the United States of America* (NDS) establishes a set of overarching defense objectives that guide DoD's security actions and provides direction for the *National Military Strategy* (NMS). It was developed based on the Quadrennial Defense Review (QDR) process and is focused on preparing DoD to meet 21st century challenges. One of the four implementation guidelines, which it details, is "Continuous Transformation." The purpose of continuous transformation "is to extend key advantages and reduce vulnerabilities."

We will continually adapt how we approach and confront challenges, conduct business, and work with others. NDS, March 2005

No area needs transformation more than DoD logistics. In fact, the former Army Chief of Staff, General Eric K. Shinseki has said, "You cannot have an Army transformation without a logistics transformation." This precept can be unarguably broadened—you cannot transform the Department of Defense without transforming logistics. And, while transforming many military disciplines there are often little proven precedents, in the logistics world, many of the necessary tools and concepts have been proven in the commercial world.

The current Defense logistics budget is well over a \$100 billion and is very big business. It requires more than a million government people that receive more than 54,000

requisitions, process nearly 8,200 contracts, and conduct business with approximately 24,000 suppliers each day supporting 1,312 major weapon systems. DoD maintains an inventory of 5.2 million different items and 60 inventory reporting systems (Home Depot has around 50,000 items and one inventory system). While each element of the process (ordering, procurement, transportation, maintenance, finance, etc.) is digitized, these processes are often segmented, and are spread out across 600 different and non-interoperable information systems. Optimization, when it occurs, takes place at the element or sub-element level, rather than the system level. The current “system” is largely an ad-hoc mix of government and industry, with little cost visibility or performance accountability. An integrated (end-to-end) system does not exist (as it does in “world-class” commercial systems).

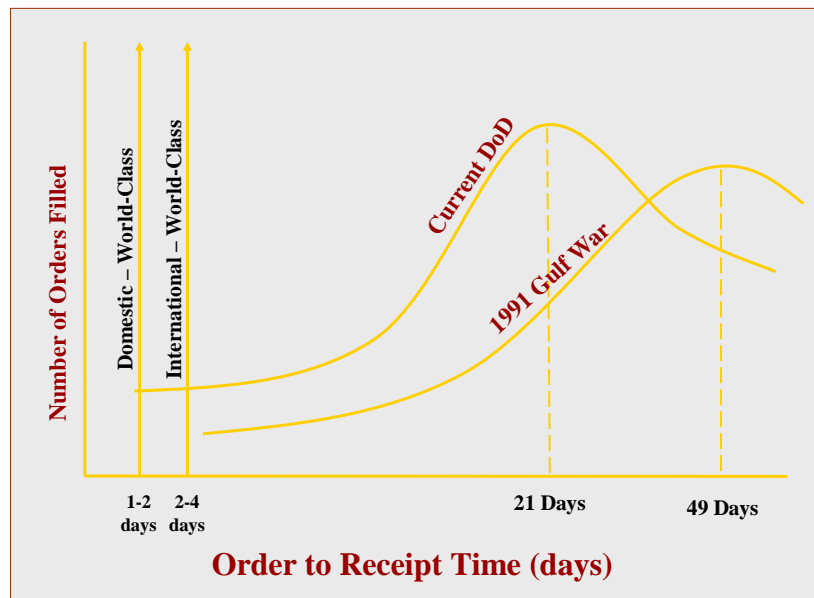


Figure 1. Logistics Results: “Successful,” but not World-Class

The DoD has been making progress, albeit slowly. During the Gulf War in 1991, it took five months to deploy troops and equipment to the Persian Gulf, and the logistics support

was developed while forces were not engaged in hostilities.¹ The average order to receipt time was 49 days. Based on the supply chain improvements over the last 15 years the average order to receipt time has been reduced to 21 days (with a still significant variation, from within days to up to a year). This is an impressive improvement, except when one considers the performance of world class commercial distribution that can guarantee delivery within 1-2 days domestically, and 2-4 days internationally, with over a 99 percent reliability (see Figure 1).

When considering weapon system support specifically, traditional DoD sustainment strategies have focused on conducting business transactions to procure parts and services in an effort to ensure maximum weapon system availability. The military services had to estimate and compute the requirements; then procure, store, and when required, ship the necessary parts. This meant that DoD customers (military services and agencies) focused on ensuring that they had enough spare parts and inventory to meet any need or requirement (often referred to as a “just in case” system). This approach tended to increase demand (the whiplash effect), compounded by a “supply push,” resulting in large inventories. The customer also bore the costs and risks for forecasting, ordering and maintaining inventory, warehousing, managing obsolescence, transportation, reliability analysis, configuration management and field engineering. This approach created incentives for the Original Equipment Manufactures (OEMs) and vendors to sell more spare parts, and maintenance, while encouraging performance and reliability improvements be incorporated in the “next” generation of equipment, often resulting in weapon systems with low availability. Finally, the increased logistics burden assumed by the customer meant that there were that many more resources that were not focused on core competencies. As a result of these factors, DoD is far still from world class and, in general, significantly less capable than the commercial sector (see Figure 2), yet at far higher costs.

¹ US Government Accountability Office, Report to the Chainman, Committee on Armed Services, House of Representatives, “Operation Desert Storm: The Services’ Efforts to Provide Logistics Support for Selected Weapon Systems”, September 1991, 2.

Process	DoD	Commercial Companies		
Distribution (in-stock items)	21 days (avg)	1 day (Motorola)	3 days (Boeing)	2 day (Caterpillar)
Repair (cycle time)	4-144 days	3 days (Compaq)	14 days (Boeing electronics)	14 days (Detroit Diesel)
Repair (shop time)	8-35 days (Army tank/truck)	1 day (Compaq)	10 days (Boeing electronics)	5 days (Detroit Diesel)
Procurement (admin lead time)	88 days (DLA)	4 days (Texas Inst.)	0.5 days (Portland General)	Minutes (Boeing, Caterpillar)

Figure 2. DoD performance compared to commercial firms (Some of this data is adapted from 1998 DSB report)

There are several specific drivers for logistics transformation within DoD. These include: the rising cost of maintenance and support for new and legacy systems; and long customer wait times in support of war-fighters, and the increased flexibility/agility required in the new (and largely unpredictable) military environment. When these are coupled with the ever-tightening budget constraints and the documented performance improvements and savings from commercial logistics support operations; there is a clear requirement to move from the traditional support models. DoD must move to a world class system that is much more efficient in peacetime, and can also quickly adjust to the demands of warfare. The benefits include significant increases in availability, reliability, along with significant cost reductions.

It must be recognized, of course, that there are clear differences between commercial requirements and the military's—particularly with regard to the end objective i.e. losing sales vs. losing lives. Thus, a “just in time” supply system would be unacceptable and some “buffers” are necessary. However, with a rapidly-responding, world-class system, this can easily be provided for; and DoD unique needs can still be met much more effectively, and at far lower costs.

B. Why DoD Cannot Get Performance Based Results with Traditional Logistics Support

Inefficiencies with DoD's traditional logistics support to weapon systems is not a new problem. DoD's traditional approach has been fragmented, with segmented accountability and control by various stakeholders (DLA, Services, MAJCOMs, Depots) all of which have their own budget requirements and restrictions, and different priorities. Additionally, the responsibility for the elements of logistics² has been shared between acquisition activities and sustainment activities. Traditional logistics metrics are focused on internal logistics processes, and rarely have a direct relationship to warfighter requirements. Efforts to optimize these elements often results in sub-optimal results at the system level (Devries 2004).

Furthermore, traditional logistics support dictates processes and design specifications; this has the effect of restricting innovation and process improvements. Suppliers and equipment manufacturers are also incentivized to sell more repair parts, vice developing and implementing reliability improvements. As a result of these factors, it is difficult to provide truly cost-effective, integrated logistics support using DoD's traditional model.

C. PBL is the DoD's Preferred Product Support Strategy

The key strategy DoD has identified to transform weapon system support is Performance Based Logistics (PBL) (see Figure 4). The goal for PBL contracts is to provide the U.S. military with a higher level of logistics efficiency and effectiveness, to improve accountability, and develop products that are more reliable. Based on the experience of the private sector and the pilot programs conducted in DoD, it is widely believed that PBL support offers the best approach for long-term support of weapon systems, and their subsystems.

² Maintenance planning; supply support; support equipment; manpower and personnel; training; technical data; IT support; facilities; packaging, handling, storage, and transportation; and design interface.

The *Defense Acquisition Guidebook* defines Performance Based Logistics as “...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.”

When implemented, PBL shifts the focus of the government’s efforts from transactions to identifying performance outcomes and assigning responsibilities. The objective is to develop accountability, instead of using control. With PBL, active management of the sustainment process (e.g. forecasting demand, maintaining inventory, and scheduling repairs becomes the responsibility of the support provider. Additionally, it changes the incentives for the supplier. The supplier, with a properly structured PBL program, is now incentivized to improve the reliability of systems, and reduce inventories of spare parts; and with fewer repairs made and fewer parts sold, the contractor stands to make more profit--while from the government’s perspective, PBL results in optimizing total system availability, and, at the same time, minimizing cost and the logistics footprint.

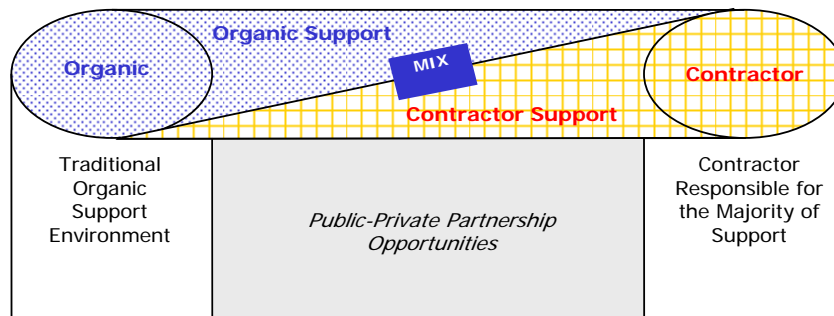


Figure 3. Spectrum of PBL Strategies (Defense Acquisition University 2005)

The Program office, using PBL, is free to combine elements of both organic and contractor support in varying degrees, leveraging their inherent capabilities, based on an overall sustainment strategy (see Figure 3). Some of the other factors that will affect this allocation are: a) the age of the system, b) existing support infrastructure, c) organic and commercial capabilities and d) legislative and regulatory constraints, such as Title 10

requirements (such as the legislated, “no less than 50 percent organic depot maintenance” provision)³. As a consequence, virtually all system support is a combination of organic and commercial support services. Identifying the best combination should be based on the best value determination; and must of course, also meet compliance with the existing laws, policies, and regulations (Defense Acquisition University 2005).

D. PBL Attributes

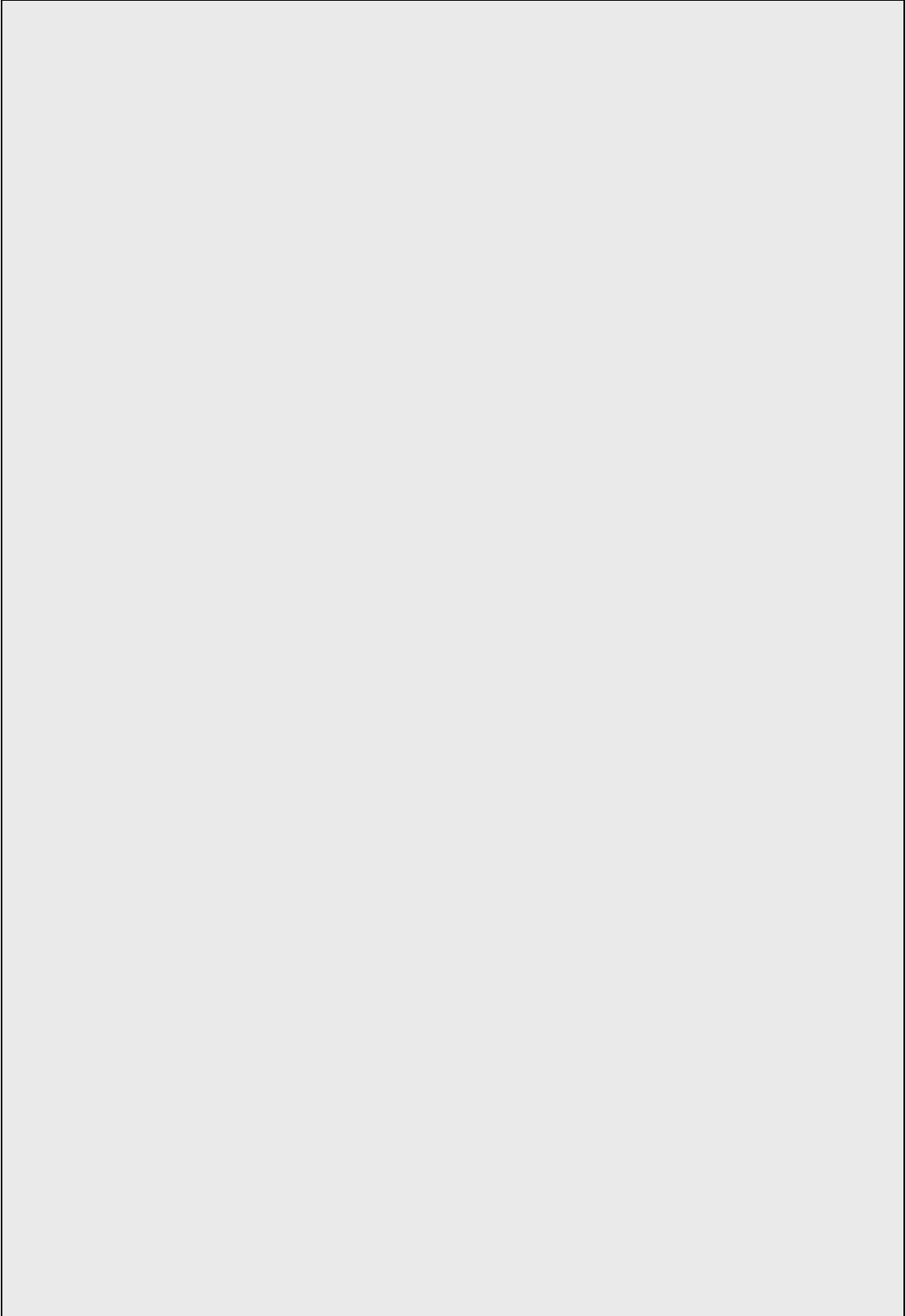
In an attempt to wring out as much system readiness as is possible from the tightening budgets, DoD is adopting PBL, a fundamental shift in the way it supports its weapon systems. The following is list of attributes we believe differentiates PBL from more traditional support arrangements.

Delineates outcome performance goal

The objective of PBL programs is to buy measurable outcomes i.e. those measures of effectiveness used, to define the outcomes. They should, at the top level, be based on war-fighter performance requirements; and include only a few simple, realistic, consistent, and easily quantifiable metrics (focused on operational performance and value-added process indicators). These metrics can then be linked, through the contract vehicle, to supplier incentives.

A written Performance Based Agreement (PBA) between the user and the program office can be used to identify ranges of outcome performance with thresholds and objectives, and the target price (cost to the user) for each level of PBL capability. In most cases, focusing on a few measures, e.g. weapons system availability, mission reliability, logistics footprint, and/or overall system readiness levels will be sufficient (see USD AT&L Memo summary in Figure 4). Based on these war-fighter requirements, suitable metrics can then be developed (Under Secretary of Defense 2004).

³ The CORE considerations cover three Sec. 2462, 2466 and 2469. Sec.2464 envisages that the DoD maintain a core logistics capability that is government owned and operated. Sec.2466 allows no more than 50 percent of the funds made available in a given fiscal year to a military department for depot-level maintenance and repair workload to be used to contract for performance by non-federal government personnel. Sec.2469 states that a public-private competition is required to move depot-level workload valued at over \$3M annually from an organic depot to the private sector.



Ensures responsibilities are assigned.

A PBL effectively switches most of the risk and the responsibility for supply chain management from the customer to the supplier, for the system, or part, that is managed. For example, pre-PBL, the DoD customer does not have the visibility to make financially-sound decisions due to the many “silos” associated with the full spectrum of the traditional supply chain management (e.g. acquisition, engineering, procurement, comptroller, and logistics). With a PBL contract, the customer understands the true cost of the support, making his financial forecasts and budgets much more accurate. Additionally, the PBL metrics, when properly developed, further define the suppliers’ responsibilities very clearly. For example, part or system availability is unambiguous. If the contract calls for the delivery of a part within 48 hours, 95 percent of the time, it is evident to all if the supplier is meeting his obligation (Keating 2005).

Since, with PBL, the customer is freed from the detailed supply chain management, he can focus on the higher level tasks. These include developing the appropriate performance outcomes, developing a system supply chain strategy, structuring and awarding the contract, and then monitoring and assessing the performance.

Reduces Cost of Ownership

PBLs, when properly implemented, will reduce the cost of ownership of DoD weapon systems, while improving readiness. This reduction results from the decline in inventories, improved supply chain efficiency, replacement of low reliability components, and increased system availability.

Provides incentives for attaining performance goal

Each PBL should be unique and tailored to its program or situation, and strive to be a “win-win” for both the customer and the supplier. The PBL initiative should then fundamentally align the interest of the supplier with that of the customer, and lead suppliers to assume greater responsibility for providing ongoing improvements to their products. This approach is designed to provide incentives for the supplier (in most cases a contractor), so they are allowed to improve design and processes, and implement

commercial best practices. Once both parties believe they have sufficient data, the contract can migrate to a fixed price, with incentives, form. Cost savings generated from supplier-developed and implemented improvements, resulting in increased performance and reduced costs, then provide savings for both the customer and supplier. With cost savings shared directly with the supplier, the suppliers are incentivized to undertake their own investment strategies to identify and improve low reliability components, enhance supply chain efficiency, and use smart decision tools that provide real-time cost and performance visibility. This ultimately leads to improved performance, reliability, and reduced costs.

E. Organization of the Report

Section I of this report provided a brief overview of the issue, defined PBL, summarized PBL guidance, and identified key PBL attributes. The next three sections are case studies of successful PBL programs at the weapon system level (F/A-18), component level (aircraft tires), and major subsystem level (submarine acoustic rapid-COTS-insertion sonar). The final section identifies barriers and enablers to PBL implementation, and overall conclusions.

In summary, with this report, the Center for Public Policy and Private Enterprise (CPPPE) has aimed to explore and evaluate three cases of DoD's implementation of performance-based logistics, and identify major key barriers and enablers.

II. PBL support for the F/A-18

A. Background

The F/A-18, designed in the 1970s, is still the backbone of Naval Carrier Strike Groups. The F/A-18 fighter is a multi-role aircraft designed to fill the roles as either a fighter or attack aircraft; and flies fighter escort, fleet air defense, suppression of enemy air defenses (SEAD),



interdiction, close and deep air support, reconnaissance, and forward air control missions. Along with the Navy and Marine Corps, the F/A-18 serves with seven foreign customers. With its inherent versatility and high reliability, it has proven to be a valuable carrier asset (Naval Air Systems Command 2005).

The newest model, the F/A-18-E/F⁴, Super Hornet, is an evolutionary upgrade to the F/A-18 C/D. The Super Hornet has a greater range/endurance, can carry a heavier payload, has enhanced survivability, and a built in potential to incorporate future technologies. Since the F/A-18s can be reconfigured quickly to fly a variety of missions, they provide the operational commander a great deal of flexibility to respond to changing battle scenarios (Naval Air Systems Command 2005). The F/A-18E/F is built by an industry team that includes Boeing, Northrop Grumman, GE Aircraft Engines, and Raytheon—they employ over 1800 suppliers nationwide. The Super Hornet entered combat on its first operational deployment in 2002

The Navy and Marine Corps F/A-18 inventory (as of 31 July 05) is comprised of:

⁴ E-model is single-seat, the F-model is two-seat.

- 151 F/A-18 A/Bs
- 530 F/A-18 C/Ds
- 228 F/A-18 E/Fs (Current)
 - 460 F/A-18 E/Fs Inventory Goal
- 90 EA-18Gs

There are an additional 409 operated by seven foreign countries. This enterprise has a significant budget. As of March 2005, the Navy's program office, PMA-265, budget for FY 2005 was \$4.4 billion, with a total budget of \$25.7 billion across the FYDP.

B. F/A-18 Sustainment Strategy

The F/A-18 Program Office and NAVICP F/A-18 Integrated Weapon System Team created an F/A-18 Integrated Sustainment Strategy with a three pronged focus. The first is to create a Virtual Program Office to focus, manage, and lead sustainment efforts of numerous government stakeholders. The second is to use multiple, OEM-centric Performance Based Logistics (PBL) contracts to provide the best value, long-term support solution for all F/A-18 A through F and EA-18G. And, finally, to focus F/A-18 performance goals on metrics driven by the performance based agreement (PBA) between the War-fighter and Program Manager (PM).

Create a virtual Program Office

The first step of the comprehensive sustainment strategy was to organize all the government stakeholders into a virtual program office to focus, manage, and lead the F/A-18 sustainment effort (see Figure 5). These stakeholders included the Naval Inventory Control Point (NAVICP), the Naval Depots, the Fleet Support Teams, the Naval Air Warfare Centers, the Naval Air Technical Data and Engineering Service Command, the DLA supply centers, the NAVAIR program offices for Air Combat Electronics Aviation Support Equipment, and of course the F/A-18 Strike Fighter Program, the fleet Aircraft Intermediate Maintenance Departments, and the Marine Aviation Logistics Squadron.

The F/A-18 Program Manager was the overall manager, and the NAVICP F/A-18 Integrated weapon support team assumed the responsibility of the Product support integrator. These are to act as the program manager's agent for implementing his sustainment vision/objectives; coordinate organic/private sector support to maximize readiness at the lowest cost; and, finally to manage all support contracts, memorandums of understanding, and memorandums of agreement, to meet the metrics specified in the Performance Based Agreement (PBA).

F/A-18 Virtual Program Office

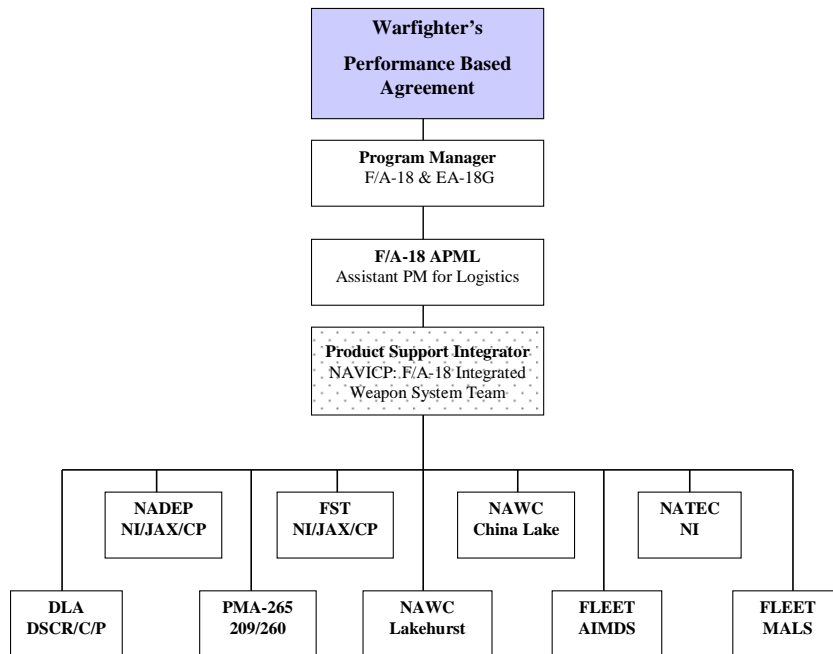


Figure 5. Sustainment Organization (Heron 2006)

Use multiple Performance Based Logistics contracts to provide best value

The vision of the sustainment strategy is to develop and implement a comprehensive F/A-18 support plan that will provide the required readiness for the Navy, while reducing resource utilization and costs. The approach chosen was not to use a single PBL contract at the system level, but instead to apply the PBL concept at the sub-system/component level. The implementation involves the optimization of multiple PBL contracts with multiple OEMs to provide the best value, long-term support solution for specific F/A-18

systems, sub-systems, and components. This approach is consistent with the commercial “best practices” used by successful, low-cost airlines, such as Southwest⁵

PBL metrics driven by a Performance Based Agreement

The F/A-18 Performance Based Agreement (PBA) was an agreement between the F/A-18 program manager, the Commanders of the Strike Fighter Wings (Atlantic and Pacific), and the Commander Naval Air Forces. The PBA, approved in the summer of 2005, established Ready-for-Tasking (RFT) and Cost-Wise Readiness performance objectives for the Navy’s F/A-18 (Heron 2006). “Cost-wise readiness” is a concept adopted by the Navy to find efficiencies in achievement, and to move away from the idea of “readiness at any cost.” It involves evaluating and adopting “best practices” from other disciplines, across other professions, to include government and industry, in order to make Naval Aviation as efficient and effective as possible (Malone 2004). Once the PBA was signed, these performance objectives were integrated into the F/A-18 Integrated Sustainment Strategy (Heron 2006).

C. Contract Details

F/A-18 Integrated Readiness Sustainment Team (FIRST)

The central pillar, and by far the largest PBL contract under the integrated sustainment umbrella, is the F/A-18 Integrated Readiness Sustainment Team (FIRST) contract with Boeing. The original FIRST contract was awarded by NAVICP on May 1, 2001, and created a teaming arrangement between industry and the Navy, to provide material supply support, to include provisioning, warehousing, shipping, transportation, obsolescence management, reliability improvements, total asset visibility, and configuration management for the F/A-18 E/F Super Hornet. The overall goal was to reduce the Total Ownership cost (TOC), and incentives were provided for innovation and efficiency improvement to reduce the Super Hornet total life cycle cost (Aguilar 2005).

⁵For example, Southwest Airlines has a 10 Year engine maintenance contract with GE Engine Services, Inc. They pay a per flight hour rate for almost all engine maintenance on the airline's 737-300 and -500 Fleet.

The contract gives Boeing responsibility for the support process for parts particular to the F/A-18E/F aircraft including responsibility for meeting demand requirements, improving system and parts reliability and availability, and managing obsolescence. Boeing also became the supply chain manager for those parts, including forecasting, parts management, transportation, distribution, and warehousing.

The baseline contract was cost plus incentive/award fee, with three successive one-year ceiling-priced options. In the last two option years, the contract was a fixed price plus incentive/award fee.

In April 2003, NAVAIR awarded a complimentary FIRST contract, with two one-year options. It expanded the contractor's responsibilities to include the provisions to provide integrated logistics support, program management support, in-service engineering, support equipment, technical publications, a Support Center, and integrated information systems for the F/A-18 E/F Super Hornet (IDA 2006).

NAVICP awarded a new, single FIRST contract in December, 2005 that combined the separate supply chain management and integrated logistics support contracts (see Figure 6). The five year, \$995M firm fixed price base contract includes a five year extension option. This contract includes fleet driven performance requirements, and covers 73 percent of the Super Hornet's elements⁶. This 73 percent includes 3889 E/F weapons replaceable assemblies (WRAs) and shop replaceable assemblies (SRAs), 653 intermediate level repairables, 349 Support Equipment Items, 170 DLA consumables, 13,080 DLA second source consumables and 10,970 Non-DLA consumables. The Justification and Authorization (J&A) was approved for \$2.9 billion, providing the flexibility to expand support to all F/A-18s. Since NAVICP signed this single contract, NAVAIR will transfer their portion of the funds to them.

⁶ This contract does not currently cover F/A-18 A through Ds WRAs or SRAs or engines, tires, explosives, and government furnished equipment.

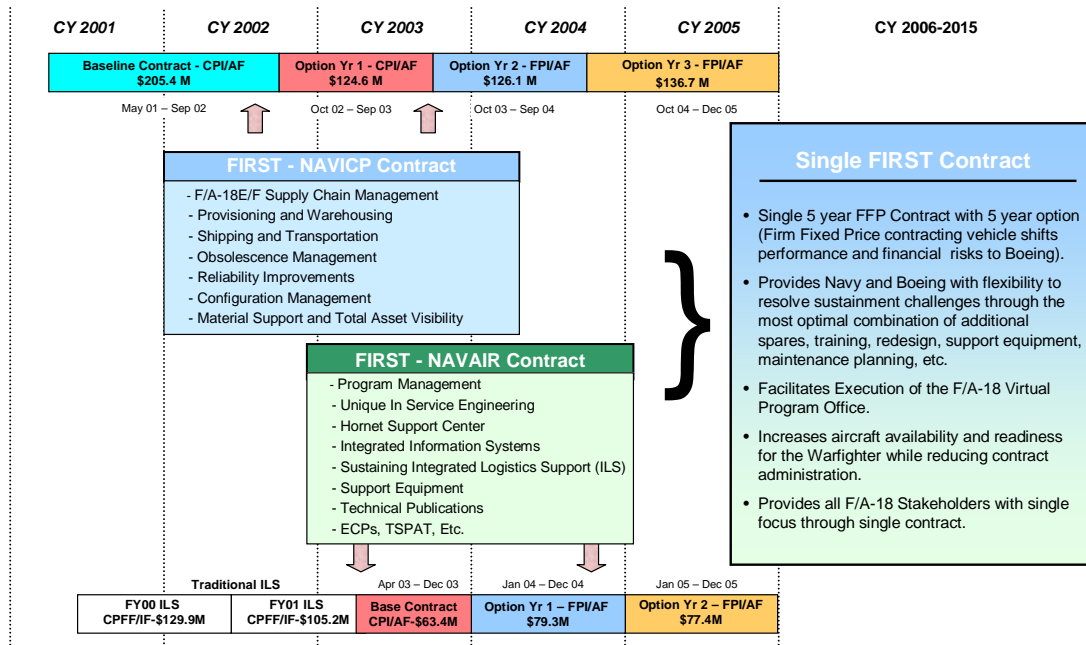


Figure 6. Migration to a Single FIRST Firm Fixed Price Contract

In addition to all of its suppliers and vendors, Boeing has also formed public-private partnerships with the Navy depots to combine commercial supply chain capabilities with organic repair expertise, and also to comply with section 2464, title 10. This teaming agreement uses Commercial Services Agreement (CSA) to define business relationships and Task Description Document (TDD) to define work scope details. In the Industry-NADEP partnership, Boeing would provide advanced funding, repair parts, transportation to/from NADEP and technical support while NADEP would perform the repair within the negotiated turnaround time, provide bulk material, failure data, and suggest reliability improvements. There is also an integrated information technology infrastructure that provides total asset visibility (TAV) across the team. Finally, there is also a Proprietary Information Agreement (PIA) to protect proprietary rights of all the parties concerned.

To support the remainder of the sub-systems the program office has awarded or has pending the award of PBL contracts to support applicable subsystems/components, as well as leveraging Navy PBLs that support multiple systems, such as tires (see Figure 7) (Heron 2006). A few examples are described below.

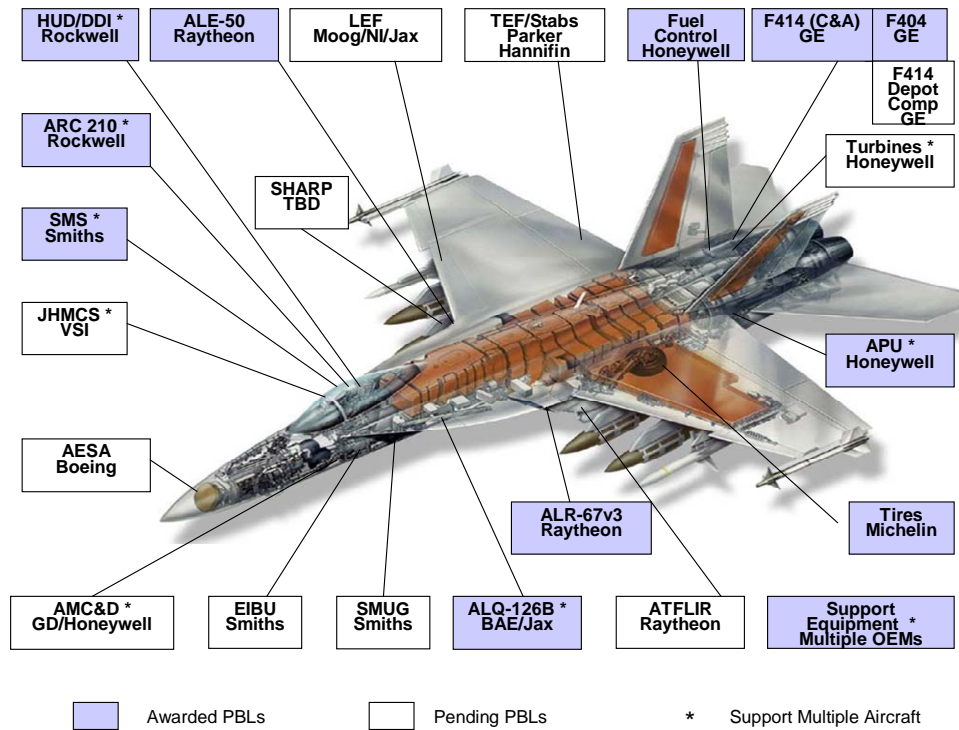


Figure 7. F/A Awarded and Pending PBLs by Subsystem

The (F/A-18A-D) F404 engine PBL

This sub-system level contract for the F404 PBL was a four and half year, firm-fixed price contract, with the possibility of five one-year additional ordering periods. With a cost of \$510 million, it was the second largest aviation fixed price PBL contract, which includes 36 F404 major sub-assemblies covering 1895 engines where the business case analysis projects \$79M in cost avoidance (Jeff Heron PBL Presentation).

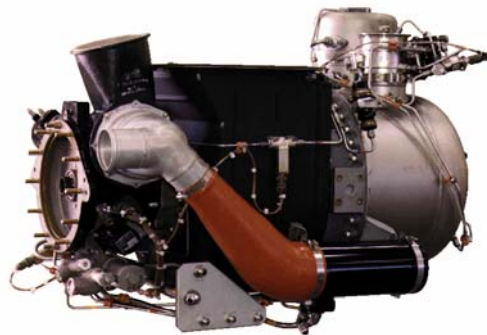


It covers the overhaul of major sub-assemblies regardless of quantity repaired or replaced and provides flying hour and war-time surge flexibility. Measurable performance metrics are used, and include logistics response time (LRT), supply material availability (SMA) and durability. The availability

standard is set at 85 percent with disincentives for an achievement lower than 75 percent and incentives up to 3 percent for 90 percent availability. Pre PBL the SMA was 55 percent. The public-private partnership with NADEP Jacksonville leverages OEM “Best Practices” efficiencies like Six Sigma and Lean manufacturing (Heron 2006).

The Auxiliary Power Unit (APU)

The Honeywell Total Logistics Support component level PBL is based on a commercial ‘Maintenance Service Agreement’ and was awarded in June 2000 to provide support for APUs used on the C-2, F/A-18, S-3, and P-3 aircraft. It is a 10 year performance-based, firm fixed price



contract with 5 year base, and 5 one year incentive terms. It was the Navy’s first public-private partnership between NAVICP, NADEP Cherry Point, and Honeywell, with an objective of guaranteeing increases in reliability and availability. The pricing was per

flight hour and the contract included obsolescence management, product support engineering, and delivery guarantees (Heron 2006).

Other sub-system level PBLs

Other sub-system level PBLs awarded include \$360 million F/A-18 Displays in September 2003 for a five year base with two 5 year options, the \$99 million F/A-18 Stores Management System awarded in September 1999 for 15 years and the \$20 million ARC-210 awarded in February 2001 for 5 years (Jeff Heron Presentation).

D. Program Performance

The F/A-18 sustainment strategy was intended to improve readiness and lower support costs (the Business Case Analysis conducted by NAVAIR projected a cost avoidance of \$1.4 billion over 30 years, reduction in repair turnaround time from 60 to 45 days and an increase of 10 percent in aircraft reliability (Aguilar 2005)). The program steadily improved Super Hornet mission capable rate (see Figure 8) from a rate of 57 percent to 72 percent in 2005. The program has also demonstrated the ability to support aircraft availability during wartime—aircraft had a 97.5 percent sortie completion rate during operation Enduring Freedom. Additionally, aircraft carrier depth and range stockage effectiveness was 99 percent, and the overall the non-mission-capable for supply/partially-mission-capable for supply, and cannibalization actions were reduced.

The improvements in availability were based on process improvements and on supportability cost reduction initiatives. The FIRST engineering change proposal (ECP) process reduced the approval time from the previous 157 days to 39 days, a reduction of 75 percent. The average depot turnaround was reduced from 90 days to 45 days, a reduction of 50 percent, based on improved parts availability. One change decreased the beyond capability of repairs rate for the generator control unit (GCU) (previously one of the top ten degraders) and increased the intermediated level ready for issue rate from 30 percent to 75 percent, an increase of 250 percent. In addition to the improvements to performance, the non-recurring investment of \$19.8 million in supportability cost reduction initiatives is driving a lifetime cost avoidance of \$430.2 million (Heron 2006).

Super Hornet Readiness Status

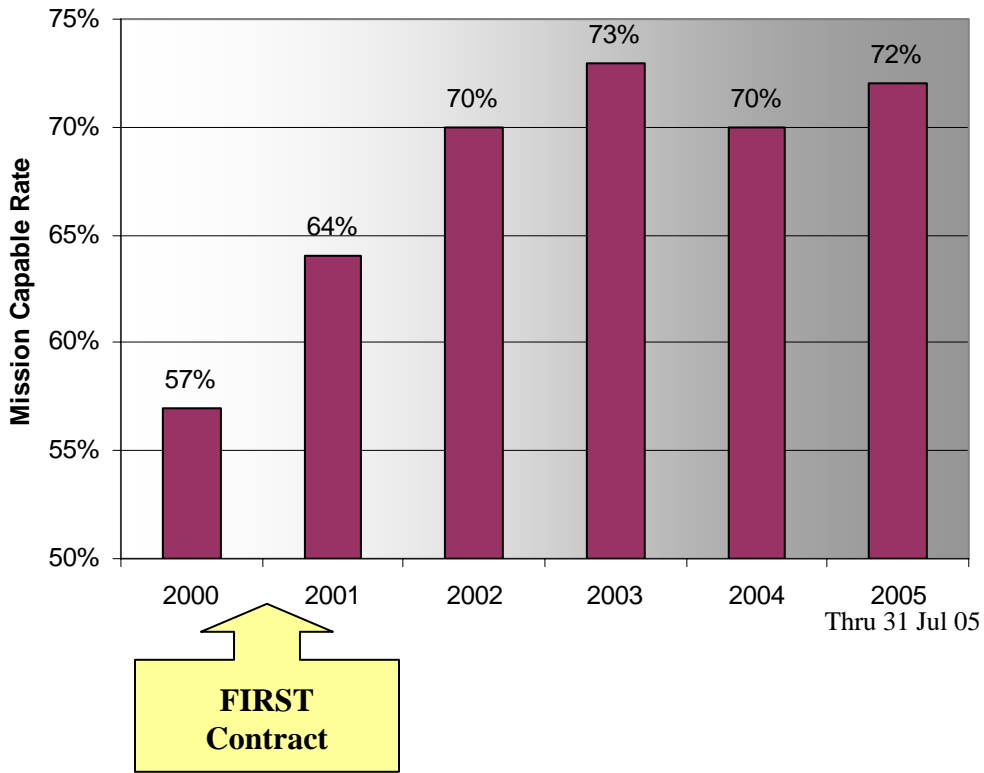


Figure 8. Hornet Readiness Status (Heron 2006).

Under a traditional (non-PBL) support scenario, the cost of F/A-18E/F spares and repairs based on a historical support costs was projected (based on the historical support cost for the F/A-18 C/D) to increase at an annual rate of 7 percent. With the current “FIRST” contract, the cost of spares and repairs are stabilized with the firm-fixed price contract. The program projects a savings of approximately \$150 million during the base contract 5 year period (see Figure 9) (Heron 2006).

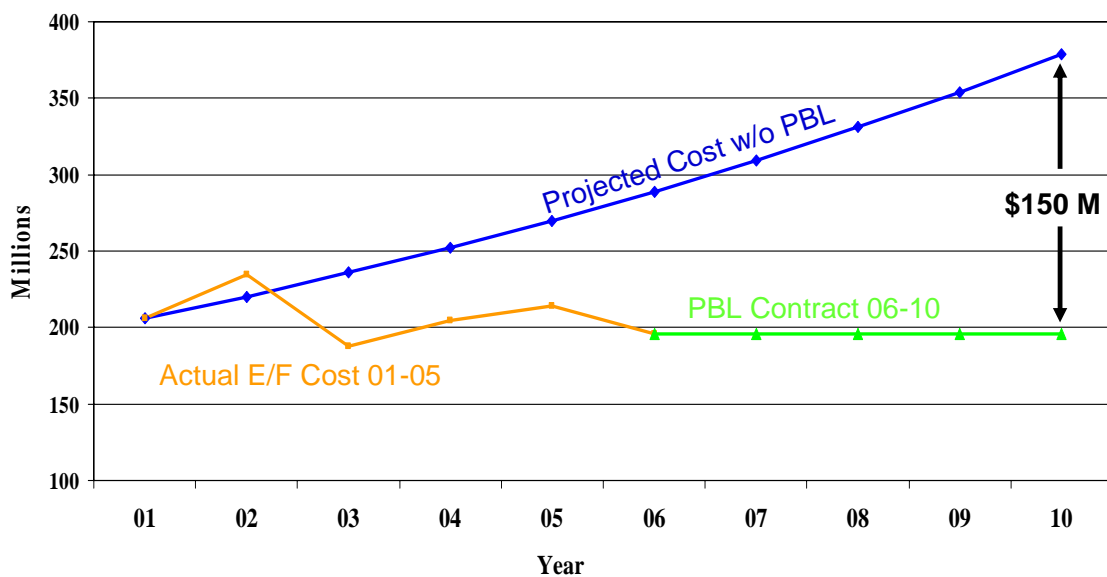


Figure 9. “FIRST” Stabilizes the Cost of F/A-18 E/F Spares and Repairs (Heron 2006)

In addition, the performance of other F/A-18 PBL contracts has also contributed to the overall improved readiness (see Figure 10 for summary). Some details of two major subsystems, the F404 engine and the APU, that have made a dramatic impact are provided (Heron 2006):

- The Navy GE F404 engine PBL--availability improved from a historic figure of 43 percent to 96 percent, while reducing cost per engine flying hour—the highest level since its introduction to the fleet.
- The Navy Honeywell APU total logistics support program--increased availability from 70 percent to 90 percent, reduced backorders from 123 to 5, reduced depot turnaround time from 98 to 67 days, all with a cost avoidance of \$50 million.

Sub-System	Pre-PBL	Post-PBL
Stores Management	65%	98%
Tires	81%	98%
ARC 210 Radio	70%	98%
F404 Engine	43%	96%
APU C/D	70%	90%
APU E/F	70%	100%

Figure 10. PBL Availability Successes

In summary, the F/A-18 sustainment strategy has had a dramatic impact on the readiness of the Navy’s frontline fighter. The creation of the virtual program office has brought together the all of the government stakeholders and provided them a single focus—affordable readiness. The PBL contract metrics were formulated to support the readiness requirements of the warfighter, and formalized in an agreement with the program office. Then with the aggressive implementation of PBLs the readiness improved dramatically, while reducing costs.

III. Aircraft Tires

A. Background

In 1999, the Naval Inventory Control Point (NAVICP) was still responsible for maintaining the Navy's inventory of aircraft tires, and maintained an inventory of approximately 50,000 tires. The Navy was maintaining this large inventory, but did not have the tools in place to ensure that the right tires were in the right place, at the right time. Then a decision



was made to transfer the inventory management function for tires to a contractor, using a performance based contract. NAVICP, responsible for more than 400,000 items of supply, an inventory valued at \$27 billion, and \$4.2 billion in annual sales, had already used PBL to transform other supply chains, improving performance and reducing costs (Mahandevia 2006).

B. Contract Details

In May, 2000 NAVICP issued a Request for Proposal (RFP) for a PBL contract to manufacture and deliver naval aircraft tires to all U.S. Navy, Marine Corps and foreign military sales customers (NAVICP 2000). The contract was competitively awarded in April 2001 to Michelin Aircraft Tires Corporation (MATC), Greenville, S.C. This firm-fixed-price contract had a five-year base (with two five year options) with an estimated value of \$67.4 million, supporting all 23 types of tires that the Navy uses (NAVICP 2001).

Through this innovative contract, Michelin, teamed with Lockheed Martin, serves as the single logistics integrator and it is responsible for requirements forecasting, inventory

management, retrograde management, storage, and transportation. Tires deliveries are guaranteed (at a 95 percent rate) within two business days for requirements within the continental United States, and four days for overseas requirements. Surge capability is guaranteed, at a rate of up to twice the monthly demand rate of each tire type. The contractor also provides a service center that is available 24/7, with web-based access that provides real time requisition status, shipping status, and product support information and provide data to Michelin to maintain their internal systems(Grosson 2006). This was the first time the DoD contracted out the support for new and repairable tires. The first five year option was exercised in July 2005, with an award of \$92, 884 to MATC (DoD 2005).

Lockheed Martin is a subcontractor to MATC and manages the support center, as well as the commercial carriers and the 3rd party logistics warehouse provider (see Figure 11 below).

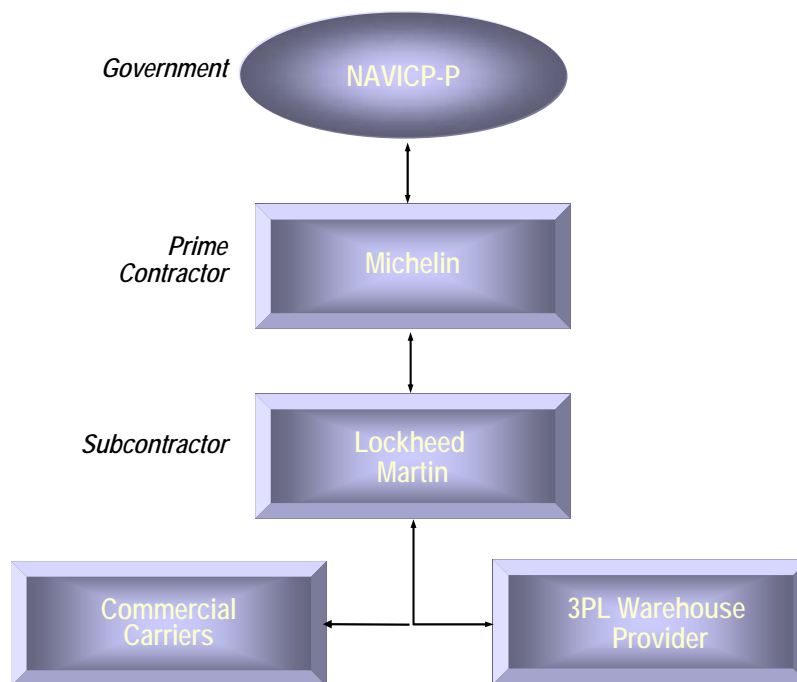


Figure 11. Program Structure

The performance of each subcontract is tied to the requirement in the prime contract, ensuring the team members are fulfilling their roles.

C. Performance

The program shipped its first tires on July 9, 2001, and today supports 16 aircraft types with 23 different tire sizes. Through mid-2005 the program has successfully delivered over 45,000 shipments consisting of 136,000 tires. The actual customer wait times have averaged about 33 hrs for continental U.S. requisitions, and about 59 hours for overseas requisitions—on-time fill rates have consistently exceeded the 95 percent minimum and have recently approached 99 percent (see Figure 12). This is a significant improvement over the legacy approach—for example, prior to this initiative the tire availability was 81 percent (Grosson 2006) (Mahandevia 2006).

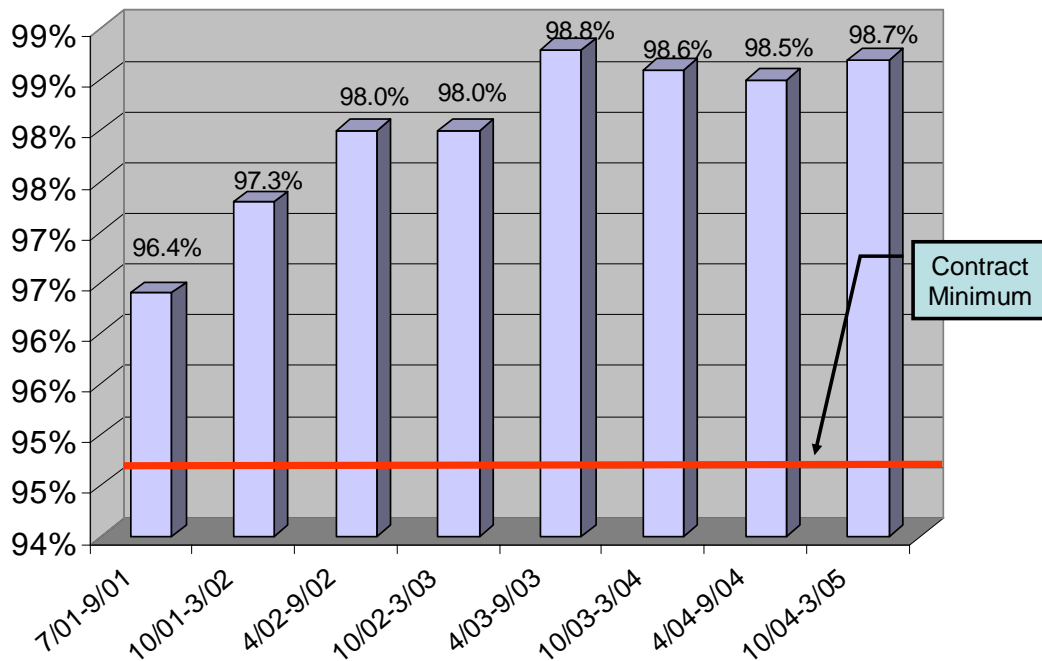
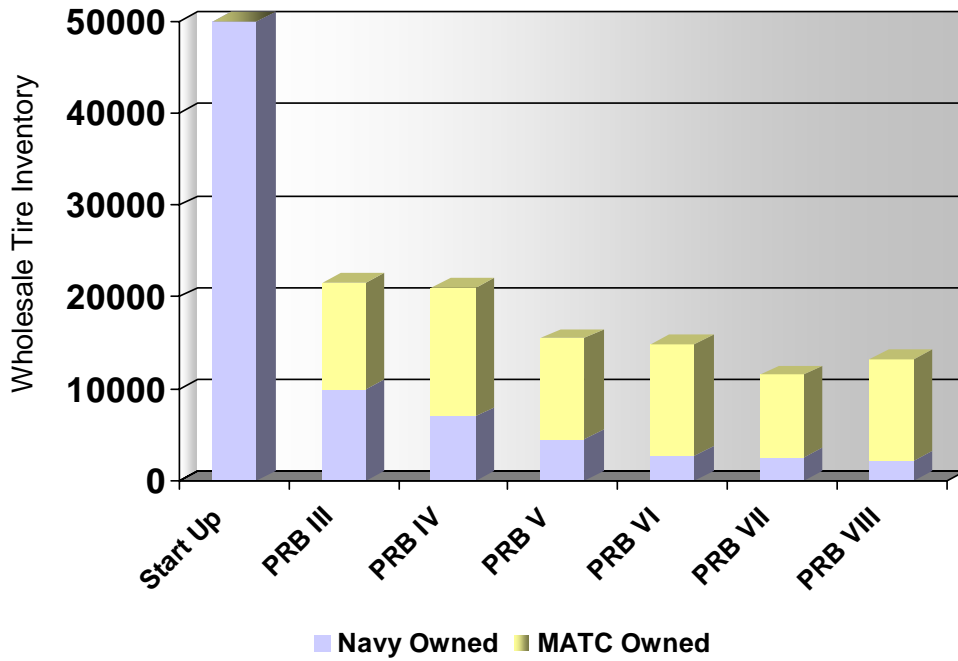


Figure 12. Tire Performance (Grosson 2006)

Finally, the wholesale tire inventory has dropped from approximately 50,000 tires to approximately 13,000, with only 2200 of those owned by the Navy (see Figure 13) (Grosson 2006; Mahandevia 2006).



Performance Review Boards (PRBs) are schedule at six month intervals

Figure 13. Tire Inventory (Grosson 2006)

This innovative approach, leveraging the commercial supply chain processes, has transformed the way the Navy manages its aircraft tire supply chain. This program has virtually taken the Navy out of the business of buying and storing tires, improved the performance to the fleet, and is projected to save the Navy over \$46 million over the life of the contract.

IV. A-RCI and Virginia S/CC/A

A. Background

The U.S. Navy's submarine force lost its lead in detecting and tracking foreign submarines in the 1990s. Other countries began using advanced quieting technology on their modern diesel-electric submarines. In addition, the end of the cold war was accompanied by reduced research and development funding. As an interim fix, operating forces began using carry-on commercial systems in an effort to regain some of their previous advantage.



These “black boxes” however, were not fully integrated with the ship’s combat system, limiting their effectiveness (Kerr 2004).

Developing unique systems that met military specifications would have cost \$1.5 billion dollars in development, and \$90 million per ship-set; figures that were deemed unaffordable. The Navy chose a different path. The Chief of Naval Operations (CNO) Submarine Acoustic Master Plan stated a vision for the acoustic capability of Navy submarines : *“Aggressively incorporate flexible, affordable and innovative technologies to restore and maintain acoustic advantage, ensuring tactical control, maritime battlespace superiority, and comprehensive undersea surveillance(Rosenberger 2005).”* NAVSEA was tasked and began developing an acoustic system based on commercially available hardware and software, designated the Acoustic Rapid Commercial off the Shelf (COTS) Insertion (A-RCI) sonar system.⁷

This approach leveraged state-of-the-art commercial systems and used advanced signal processing algorithms to exploit the much quieter acoustic signatures of the target

⁷ Key improvements of this sonar implementation include a larger acoustic aperture with precision matched acoustic channels, an expanded outboard pressure tolerant electronic component configuration, and the ability to pass element level data inboard(Applied Research Laboratory 2006).

submarines. Furthermore, this COTS-based approach reduced the ship-set cost down to approximately \$10 million. Since A-RCI was also designed to replace a number of different sonar systems with a common system, the Navy was also able to reduce the support infrastructure, as well as increase the experience levels of maintenance and operational personnel (Kerr 2004).

The first A-RCI hardware suite consisted of custom cards that were prone to failure, as well as difficult to program. These signal processing cards, although technically a COTS product, were very specialized with high procurement costs. They also required the use of an operating system with limited peripheral driver support. Since this initial application used the COTS hardware and software in non-standard configuration, getting vendor support and leveraging lessons learned from commercial implementations was difficult (Kerr 2004).

B. Program Description

The A-RCI is a four-phase program for transforming submarine sonar systems (AN/BSY-1, AN/BQQ-5, and AN/BQQ-6) from legacy systems to a more capable and flexible COTS/Open System Architecture (OSA) and is designated AN/BQQ-10. In addition to providing submarine force with a common sonar system, the COTS/OSA approach provided other benefits that include: added ease of update for technical improvement, reduced operations and support costs, improved competition, and increased software portability (Boudreau 2006).



The use of COTS/OSA technologies and systems will enable rapid periodic updates to both software and hardware. The program employs a spiral development approach to develop new hardware architecture, referred to as a Technology Insertion (TI), every two years. The software is updated on an

annual cycle, to create a new software baseline. This approach allows the Navy to take advantage of rapid advances in computer technologies and processes, in the dynamic commercial technology market (Rosenberger 2005).

The first two technology insertions to the A-RCI hardware baseline were done to eliminate most of the custom cards used in the initial system configuration, and to provide improved display performance. Elimination of the custom cards reduced system cost, improved system reliability, and made software programming easier and faster. Now, instead of having to code at an assembly level to discrete hardware components, the code could be written in a high-level language (typically C). This enabled the maximum use of COTS operating system features. Additionally, this made the writing of software more straightforward, and allowed the programmers to spend more time writing better code and debugging problems instead of dealing with the details of the hardware interface. As processor capability increased, the signal processing applications were migrated to the Intel x86 family of processors (using the Linux operating system), significantly reducing acquisition cost. The technology insertions in 2002 and 2004 continued the migration to mainstream COTS hardware and software, when both the signal processing servers and display servers were changed to Intel XEON-based servers running at higher clock speeds. Now that both the display and signal processing servers were using a common hardware baseline, data transfer was now more straightforward, simplifying software development. The process has expanded from what was simply a single sonar sensor and processor, to a complex system of systems that includes all sensors, ship's navigation, combat/fire control, and ship monitoring functions (Kerr 2004).

The A-RCI program addressed the challenge of modernizing the Navy's sonar capability, while under severe budgetary pressure, with an innovative approach that was able to leverage the rapid advances in computer technology. This required a significant cultural change, in the contractor, as well as the Navy, that meant the adoption of an open system architecture and a retreat from MIL-SPECS.

One of the ramifications of this approach was the need to reengineer the logistics support. The Navy teamed with the contractor and developed an innovative performance based logistics concept that proved to be as innovative as the system design.



The current performance based logistics contract (cost plus fixed fee) was signed with Lockheed Martin's Maritime Systems & Sensors (Manassas)⁸ in September 2004. Lockheed Martin provides comprehensive A-RCI and Virginia Class sonar,

combat control, and architecture (S/CC/A) supply chain management services to NAVICP, that include: requisition processing, material fulfillment and transportation, inventory management and storage, material repair, and feedback on the technical insertion program.

The contract also identifies simple, yet very specific, performance metrics. The requirement for supply material availability is 85 percent. The contract also specifies average customer wait time for both continental U.S. (CONUS) and outside the continental U.S. (OCONUS). These are 2 and 3 days respectively, for issue priority group (IPG) I, and within the required delivery date for IPG II (Weir 2006).

For the A-RCI contract, there are certain advantages to using a cost plus contract structure. Since COTS computer hardware prices generally trend downward, the customer could actually pay higher prices under a fixed price contract. Additionally, this contract provides flexibility to adapt to the rapidly changing technology; a fixed price contract would be too 'rigid' in this dynamic environment and reduce flexibility for the Navy. The award fee provides an incentive to stay within budget; and, since reduced costs increase the contractor's rate of return, and there are additional incentives for the

⁸ MS2 is a Lockheed Martin business unit with six major sites: Moorestown, NJ; Syracuse, NY; Eagan, MN; Baltimore, MD; Manassas, VA and Akron, OH

contractor to reduce costs. Moreover, reducing costs allows the contractor to be considered favorably by the Navy for continued work on this effort (Weir 2006).

The program is responsible for the entire requisition process from identifying the required parts up until they are transported to the fleet or to the point of debarkation (for overseas delivery) where responsibility ends. The program facility is the hub for the entire process of storing inventory and repairing failed material. The program manager monitors this entire process and can keep improving it through trend analysis and feedback to customer and internal teams, and can help them decide on item replenishment on the basis of various factors. Besides, the facility is the only one of its kind in the world to have a testing lab, which helps reduce cycle time and cost (Manassas visit).

C. Program Operation

This PBL program is responsible for managing the entire A-RCI and S/CC/A supply chain process, from processing the requisition through the transportation to the fleet or the point of debarkation (for overseas delivery). The inventory is stored and repaired at the contractor's Manassas facility. As noted above, this facility also has a testing lab, which helps reduce cycle time and cost.

Requisition Processing

The process begins with requisitions submitted by the fleet online, directly to the contractor (the contractor receives 40-50 requisitions per week). Once these are accepted and processed, a system engineer identifies and locates the inventory, and plans the repair and/or replacement. The appropriate software (and/or firmware) is loaded and then the replacement parts are fully tested in the lab. The parts are then shipped via DHL/FedEx (USPS in the case of classified material). Unless there is an emergency, requisitions are processed during normal duty hours Monday through Friday and 8 am to 12 pm on Saturdays (Manassas visit) (Weir 2006).

Inventory Management

The program has developed an innovative approach to minimize the required inventory. With the installation of a new system, the program does not buy any spare parts for repairs, since the exact nature and amount of the requirement is unknown. If a repair part is needed at this time, the PBL program “borrows” one from the vendor or the production line. In effect, during the first two years of an upgrade, the contractor facility fends for itself and does not buy a part unless absolutely necessary—maintaining a near-zero inventory of spare parts. As submarine systems are upgraded, the phased-out systems are stored, and used to support that variant of the system, that is still operating with the fleet. This procedure also cuts down on the need to buy dedicated repair parts. Additionally, when the removed, defective part is repaired, it is used to replace the one “borrowed” from the vendor/factory or taken from the warehouse. Once a failure history is developed, the contractor then maintains some minimal inventory. This process not only saves time, but reduces costs; which are the ultimate objectives of the program (Weir 2006).

Web Interface

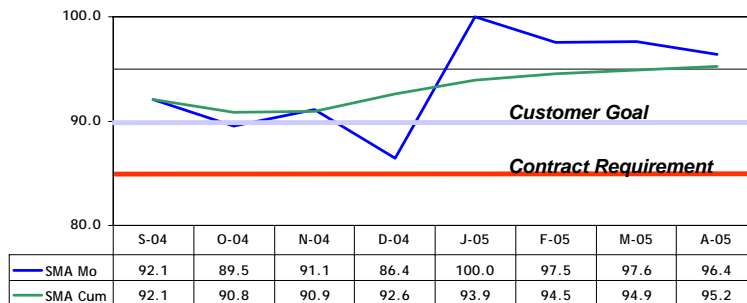
Lockheed Martin has developed a web-based portal to support this program, called the Supportability Integrated Logistics Capability (SILC™). All stakeholders (logistics, systems engineering, vendors, etc.) have access to most functions on the portal. Using this tool allows them to follow the entire replenishment process in real time. Data that these stakeholders can see includes: platform system details, including configuration; system health reports, maintenance trend analysis (e.g. failure rates for parts); supply support demand; total asset visibility (TAV); requisition process (real time data); pending requests for requisitions; real-time report lookup; and maintenance and training material. There is also a data mining capability that can search through the program’s data, to include the legacy systems. Finally, the portal also records the loan of parts from the various suppliers, to ensure that the parts are returned in a timely manner(Weir 2006).

Other key features

This program also has the ability to provide valuable feedback. For example, 50 percent of items that are returned for repair fall into two categories. One, are those identified as “no trouble found,” that means there was no hardware malfunction, and only a simple system reboot was required to affect the repair. The other category is those faults that are classified as “maintenance induced.” One specific case in point is a problem found with the operation of the power button; when it was held in too long, the server loose its unique setting, and would be reset to factory defaults. Once this was identified, new manuals cautioned the users of the impacts of this action, and also provided the procedures to restore the unique user settings (Weir 2006).

D. Performance Metrics

Contract performance for the period of September 2004 through April 2005, is summarized below. Figure 14 shows the material availability, the contract requirement is 85 percent, and the customer goal is 90 percent. During this period, the supply material availability consistently exceeded the contract requirement and the cumulative average exceeded 94 percent.

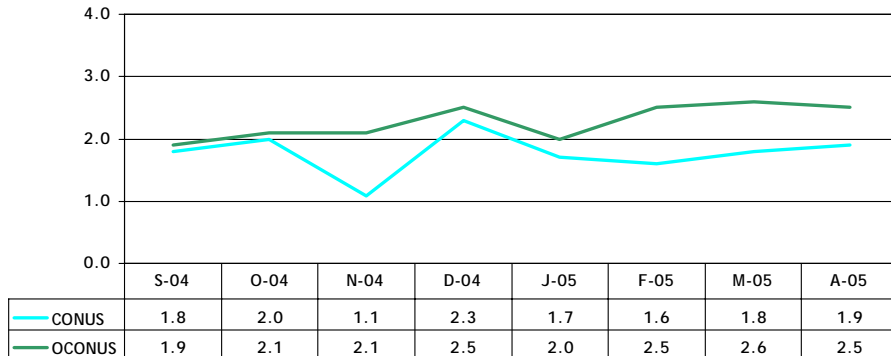


Supply Material Availability (SMA)

- Contract Req'm't 85%
- Performance >94%

Figure 14. Supply Availability (Weir 2006)

Figure 15 shows the average customer wait time for issue priority group I, for both CONUS and outside CONUS (Hawaii) locations. Both averages exceed the contract requirements. For issue priority group II, all the requisitions were filled within the required delivery date.



Average Customer Wait Time (Cumulative) Issue Priority Group (IPG) I

- CONUS 1.7 days
- OCONUS 2.3 days

All IPG II+ reqns filled within Required Delivery Date (RDD)

Figure 15. Average Customer Wait Time (Weir 2006)

Throughout the period of performance, the contractor has also steadily reduced the costs of repair. The average cost of a repair was estimated, based on the then current costs, to be approximately \$7400. The current average repair cost is slightly under \$ 5000, a reduction of 32 percent (Kerr 2004; Applied Research Laboratory 2006; Rosenberger 2005; Boudreau 2006; Weir 2006).

E. Future Outlook

The A-RCI and Virginia S/CC/A PBL program has demonstrated the ability to support the operational fleet, using multiple configurations of commercial hardware. Two of the

key reasons for the success have been the flexibility of both the partners (contractor and the Navy), and the tailoring of the program to meet its unique requirements. However, the program continues to look for ways to improve its support to fleet operations.

The program recently completed a pilot program that installed hardware, software, along with COTS based logistic capability, to demonstrate the ability to achieve a 90 day period of Maintenance Free Operation (MFOP) with a confidence of 95 percent or above. The results of the pilot far exceeded anyone’s expectations. The four submarines that participated required no maintenance, on that portion of the system designed to be maintenance free, for far in excess of the 90 day goal (see Figure 16). Based on this success, the Navy plans to continue this strategy on those four submarines (Rosenberger 2005).

Pilot Platform	Start Date	Days in Pilot	Final Available Spares
SSS 710	3-Sept-2004	392	12 of 12
SSS 721	5-Sep-2004	390	14 of 15
SSS 713	22-Nov-2004	312	11 of 14
SSS 705	8-Apr-2005	175	14 of 14

Figure 16. MFOP Pilot Program Final Results

The MFOP program also provided additional benefits; it developed and implemented a functionality to support the A-RCI system with Distance Support initiatives that: perform statistical analysis of system performance and improve availability; monitor system parameters and make recovery recommendations to system operators; and provide fast path linkages to digital technical manuals from the tactical display. With these improvements fleet operators can perform keyboard diagnostics, software reloads and other maintenance actions without opening cabinets or handling equipment (Rosenberger 2005). This approach has proven to be viable, improving operational capability, while reducing the logistics burden.

V. Findings and Conclusions

A. DoD Must Move to a World Class System

Based on the cases we studied, it is apparent that performance based logistics can be used to transform traditional weapon system support models. The PBL programs provided improved performance—improved availability and readiness levels—that approached commercial industry standards. In the longer term, as improved designs are deployed, the PBL programs will also demonstrate increases in dependability. Additionally, with PBL support, Combatant Commanders can project and sustain forces with a smaller logistic footprint, an important attribute with the current expeditionary force structure and the prospect of the extended global war on terror. Finally, there is the potential to significantly lower the total ownership costs, which can free-up needed funds for force modernization. There is a clear imperative for DoD to accelerate the implementation of PBLs in their effort to transform the traditional logistics support for weapon systems.

In the course of this research, we have identified barriers to PBLs that slow implementation, as well as enablers that should be used to accelerate it. These are described below.

B. Barriers to Implementation

Although the Department of Defense has made progress toward the goal of using PBL as the preferred sustainment strategy for its weapon systems, with some impressive successes, the transition has not been as rapid as envisioned. This is due in large part to organizational, political, and business barriers; these are described below:

Organizational Barriers

As was illustrated with the virtual program office created to manage the F/A-18 sustainment, implementing PBLs is a major crosscutting undertaking that impacts many government organizations. In the past, these organizations have often had rivalries, with their own distinct priorities, and have competed for budget share and resources. Many

weapon systems still operate with all those impediments, which must be overcome to successfully implement PBLs.

- Cultural

PBLs often require government organizations to shift their focus and to perform tasks that are different from their traditional tasks. There is, however, a natural cultural inertia that resists these, sometimes dramatic, changes. For example, legacy sustainment processes generally involve writing lengthy, detailed design specifications and statements of work, which reference many military specifications, as well as contract terms and conditions, and attempt to be so comprehensive that they cover every possible contingency. With PBLs, defense organizations are no longer writing these detailed specifications, but have had to learn how to write performance specifications.

Buying a performance outcome is significantly different from buying specific items, and often requires changes in organizational processes and manpower requirements (and, of course, there is a natural desire to protect jobs—both civilian and military). Additionally, legacy processes often keep government personnel, such as the contract administrator, and the supporting contractor in an arms-length relationship, with little trust; while with a PBL, they become active partners; and may, in fact, be selling services to the contractor. This culture of “the proper role of government” can be deeply rooted and resistant to change, especially since most government employees like to think of themselves as “core.” Finally, there is a tendency on the part of military commanders to want to “see” the required inventory, not to trust a computer-based response system.

As a result, a successful logistics transformation will require a sustained leadership commitment to change the existing culture and have it embrace the new organizational role required for successful PBL implementation.

- Human Capital.

For many of the government's logistics employees, implementing PBLs changes the nature of their work. They shift from being the "the doers" to becoming "the managers of doers." As this shift occurs, many functions of the government employees will change. For example, as the cases demonstrated, much of the supply chain management was shifted to contractors. Consequently, the government employees that formerly performed these functions will require a new skill set focused on the management of performance based contracts, and the relationships that result. This shift will require DoD to develop new strategies to recruit, develop, and sustain a workforce prepared for the challenges of their new, more complex roles.

Political Barriers--The Depot Caucus.

During the Cold War, the DoD depot capabilities expanded dramatically, with a capability to surge to 24 hour a day operations. When the Cold War ended, and the DoD force structure was reduced, there was significant excess depot capacity. When the DoD began to reduce this excess capacity, there was a concern in Congress that those efforts could go too far and, ultimately, could undermine U.S. military readiness and capabilities. This became a priority, especially for those members that had defense depots in their districts. Those members formed the Congressional Depot Caucus. And, although the DoD depot workforce was significantly reduced, there are still approximately 77,000 employees in the depot workforce, and the Depot Caucus remains actively involved in issues that impact them.

The depot caucus has been effective in passing the statutory restrictions that include the Title 10 restrictions that impose the requirement of maintaining an organic "core" logistics capability to support maintenance. DoD is also restricted from spending more than 50 percent of funds allocated for depot level maintenance and repair with contractors. Finally, DoD must use either public-private competitions or merit-based selection before shifting any depot level maintenance work, valued at more than \$3 million, to the private sector. These legislative constraints often create barriers to making best value decisions and taking advantage of industry's current capabilities.

Additionally, as the cases demonstrate, the best product support solutions often involve partnerships between industry and the organic DoD capabilities. The maximum benefits are accrued only when the best capabilities are leveraged, and this could result in many different combinations, with either industry or a government depot leading the program. However, this often implies new roles and relationships that could lead to job losses or loss of a type of work. These changes are often resisted by the depot caucus.

Business Barriers

- Funding and “Color of Money.”

Annual fluctuations in DoD budgets can create a problem for PBL implementation; they have been shown to work best with longer term commitments and stability (the contractor needs to know he will be able to get a return on his improvement investment). Another funding issue is the “color of money.” Since PBLs involve both support costs and performance investments, the funding often comes from more than one source (using operating and maintenance funds for research and development to reduce operating and maintenance costs), creating another source of friction.

Another potential funding barrier is caused by DoD’s working capital funds—this is the fund that the DoD’s providers use to buy spare parts and then sell them to DoD customers at a markup. For example, the Prime Vendor Support (PVS) initiative for the Apache helicopter failed in 2000 despite aggressive support from the Under Secretary of Defense for Acquisition, Logistics, and Technology (Jacques S. Gansler). The reason the Apache proposal failed was due to the impact it would have on the Army’s Working Capital Fund. If the Apache support were transferred to a contractor, the Army Materiel Command stood to lose up to \$60 million annually from the working capital fund. Without an appropriate reduction in organic labor, this would have driven up the cost of parts for other programs; negating the net benefit that would have otherwise accrued to the Army from the Apache decision. Efforts to implement PBL will face similar obstacles; they will challenge the income streams of DoD providers within the existing sustainment processes (Hurst 2006).

- Technical Data Rights.

In order to have the maximum flexibility when developing sustainment strategies, it is critical for the government to have the necessary technical data (detailed maintenance drawings and repair publications that contain specifications and tolerances).

However, many DoD programs negotiate buying this data separately from development and purchase of the weapon system. Then, if program managers encounter funding issues, they often forgo purchasing technical data, to preserve or improve weapon system. Obtaining the data, once the system is purchased, is generally more expensive. However, without the technical data, prudent management, oversight, and competition may be precluded.

- Loss of Competitive Pressure.

Loss of competitive pressure can occur if an OEM and/or a contractor win a PBL contract for an extended time horizon. Other suppliers may lose the ability to be competitive, without a significant investment of resources. Without competitive pressure, the lure of monopoly pricing may exceed the contracts performance incentives. Care must be taken by government managers to maintain competitive alternatives, in case the performance deteriorates, or costs begin to rise.

C. PBL Implementation Enablers

The following are enablers that can be leveraged to facilitate the transition to performance based logistics support within the DoD.

- Alignment of contractor incentives with performance requirements.

It is critical that the PBL incentives be carefully structured and aligned with the performance requirements of the system. With the incentives aligned, integration, between the provider and customer is generally improved. The support provider, appropriately empowered, can then work to improve logistics efficiency, improve performance, reduce costs, and make reliability improvements that reduce life cycle costs—this results in a win-win for both customer and provider.

- Performance metrics

Performance metrics, rooted in a Performance Based Agreement, provide a clear and objective way to measure the progress of the support provider. The Performance Based Agreement should specify a range of support to accommodate changing priorities and resources available, and therefore give flexibility to the derived metrics. The metrics need to be straightforward, measurable, and achievable.

- A total life-cycle systems management perspective

While the DoD is implementing this new sustainment strategy, the DoD inventory will include legacy/fielded systems for an additional 25-40 years. A life-cycle based perspective will improve reliability and maintainability, and better manage the cost. Even when viewed through the prism of total life cycle systems management, PBL programs still need a solid business case analysis (BCA).

When adopting a PBL approach, the product support integrator still has many alternatives, such as structuring the program at the system or sub-system level, and the mix of organic and contractor support. The BCA will allow these alternatives to be compared. The construct that provides the best life-cycle value can then be identified and selected.

- Supply chain management

Material support is a critical link in the supportability of weapon systems. The best skilled labor, advanced technology, and performance mean little without the “right part, at the right place, at the right time.” Supply chain management is an area where the commercial sector has developed superior capabilities, and is a primary target for incorporation into PBL implementation. For example, in the case of aviation tires, the contractor has assumed responsibility for all supply chain functions, with outstanding results.

- Commercial-off-the-shelf

The DoD should make maximum use of commercial off-the-shelf (COTS) systems. This would leverage the private sector's cutting edge technology and, at the same time, reduce the problems involved with the public-private interface. Generally, when organizations use COTS, they shorten the development cycle, minimize development risk, reduce 'scope creep', and leverage the rapid commercial development cycle. At the same time, they can take advantage of the existing commercial logistics capabilities.

- Public-Private Partnerships

Public-private partnership, to implement PBL, can take many forms that range from joint public-private undertakings, to private sector participation in some aspect of weapon system support, to direct sales of articles or services to the private sector. The participation in these undertakings can be totally separate, or use some more complex form of work-sharing, and can even be fully integrated in a single facility.

It is essential to achieve the right public-private mix for each program, with clearly defined and measurable expectations. In addition to satisfying the statutory requirements, using the strengths of the organic and contractor organizations can provide a better logistics solution. For example, having a contractor buy consumable parts from DLA, means the contractor can leverage DLA's greater buying power, and not have to duplicate a capability that already exists within the DoD. A capability advantage that exists with the original equipment manufacturers is their greater technical know-how and superior design capability, since they developed the system. This competency, which is difficult to duplicate, is often a key requirement for enhancing performance. In summary, public-private partnerships enable the compliance with statutory requirements, preclude the investment in redundant capabilities, and yet still maintain single point accountability.

- An Effective I.T. infrastructure

A secure, open-architecture I.T. infrastructure can facilitate the required public-private integration with the varied organizations and the many enterprise-wide systems.

E. Conclusion

The traditional way DoD did its logistics business is not suitable for today's environment. Operational requirements and funding pressures are driving the need for logistics transformation. Performance Based Logistics has demonstrated that, when properly implemented, it can play a significant role in transforming traditional sustainment strategies. Integrating the strengths of the organic capabilities, with those of the private sector, results in a win-win solution where the whole is greater than the sum of its parts. The support providers can leverage their competency advantage in technical and supply chain management issues, allowing the product support integrator to focus, not on individual transactions, but on performance outcomes.

The policy framework and the technology are available to move to a broader and more comprehensive implementation of PBL across the DoD. The question is, will it happen rapidly, efficiently, and effectively; or slowly, begrudgingly, and with great cost? If we are to maintain our military and economic security, we do not believe there is a choice.

Reference List

1. Applied Research Laboratory. *Research Highlights: High Frequency Submarine Sonar*. Web page, [accessed April 2006]. Available at <http://www.arlut.utexas.edu/atl/research.html>.
2. Boudreau, Michael. 2006. *Acoustic Rapid COTS Insertion (A-RCI): A Case Study in Modular Open Architecture Design*, Web page, [accessed July 2006]. <https://acc.dau.mil/CommunityBrowser.aspx?id=45000>.
3. Defense Acquisition University. 2005. *Performance Based Logistics: A Program Manager's Product Support Guide*. Fort Belvoir, VA. March 2005.
4. Department of Defense. 2001. *Quadrennial Defense Review Report*, Sept 21, 2001.
5. ———. 2003a. *The Defense Acquisition System*, Directive 5000.1, May 12, 2003.
6. ———. 2003b. *Operation of the Defense Acquisition System*. DoD Instruction Number 5000.2. May 12, 2003.
7. ———. 2005 *Navy Contracts for July 11, 2005* DoD. Web page [accessed July 2006]. <http://www.defenselink.mil/Contracts/Contract.aspx?ContractID=3047>.
8. Devries, Hank J. 2004. *Performance-Based Logistics -Barriers and Enablers to Effective Implementation*. Defense Acquisition Review Journal: 243-53. December 2004.
9. GAO. 1991. *Operation Desert Storm - The Services' Efforts to Provide Logistics Support for Selected Weapons Systems*, Report to the Chairman, Committee on Armed Services, House of Representatives. NSAID -91-321. Sept 26, 1991.
10. GAO. 2004. *Defense Management - Opportunities to Enhance the Implementation of Performance Based Logistics*. GAO-04-715. Aug 16, 2004.
11. GAO. 2005. *Defense Management - DoD Needs to Demonstrate that Performance-Based Logistics Contracts are Achieving Expected Benefits*. GAO-05-966. Sept 09, 2005.
12. GlobalSecurity. *BQQ-10 A-RCI Acoustic Rapid COTS Insertion*. Web page. [accessed April 2006]. Available at <http://www.globalsecurity.org/military/systems/ship/systems/an-bqq-10.htm>.
13. Grosson, Joe. 2006. *Interview with Mr. Grosson, Managing Director, Enterprise Logistics Technology Office, Lockheed Martin*.
14. Heron, Jeff, 2006. *Interview with Jeff Heron, PBL Policy Director Logistics and Industrial Operations Resources and Policy, Naval Air Systems Command*.
15. Hurst, Dana. 2006. *Performance Based Logistics – A Bridge Between Acquisition Reform and Logistics Supply Chain Management*, U.S. Army War College, Carlisle, PA. March 1, 2006.
16. IDA. *DoD Reduction of Total Ownership Costs Program: The F/A-18E/F Super Hornet*. Web page, [accessed April 2006]. Available at <http://ve.ida.org/rtoc/open/SIP/hornet.html>.
17. Keating, Scott and Kurt Huff. 2005. *Managing Risk in the New Supply Chain*. IEEE Engineering Management. Feb/Mar 2005. Vol. 15. No. 1. pp. 24-25.

18. Kerr, Gib and Robert W. Miller. 2004. *A Revolutionary Use of COTS in a Submarine Sonar System*. CrossTalk, The Journal of Defense Software Engineering. November 2004.
19. Mahadevia, Devi, Robert J. Engel and Randy Fowler. 2006. *Performance Based Logistics, Putting the Rubber on the Ramp*. Defense AT&L Magazine. July-August 2006. pp.30-33.
20. Malone, Michael D. VADM. 2004. *From Readiness at any Cost to Cost-Wise Readiness*. The Hook, Magazine of the Tailhook Association, Summer 2004.
21. Mann, Lynn. 2004. *Michelin and Lockheed Martin Celebrate 100,000th Tire Shipped in U.S. Navy Logistics Program*. Michelin Press Release Web Page [accessed July 2006]. <http://www.airmichelin.com/releases/2004-05-03.doc> Greenville, S.C.
22. Naval Air Systems Command. 2005. *U.S. Navy Fact Sheet: F/A-18 Hornet Strike Fighter*. [accessed August 2006]. Available at http://www.navy.mil/navydata/fact_display.asp?cid=1100&tid=1200&ct=1
23. NAVICP. 2000. *Statement of Work Performance Based Logistics of Aircraft Tires*. Commerce Business Daily. April 14, 2000.
24. ———. 2001. *Innovative Contract Save Navy Millions*. Philadelphia, PA. NAVICP Press Release, April 27, 2001.
25. ———. 2002. *Aircraft Tire Team Rolls into Winners Circle*. Philadelphia, PA. NAVICP Press Release. June 27, 2002.
26. Rosenberger, Roger N. Don Altizer, Jim Odish and Sherill Steed. 2005. *ARCI Maintenance Free Operating Period Pilot Program Final Report*. November 4, 2005.
27. Under Secretary of Defense, Acquisition Technology and Logistics. 1998. *The Defense Science Board 1998 Summer Study Task Force on DoD Logistics Transformation*. Volume II Panel Reports. December 1998.
28. ———. 2002. *Memorandum for Assistant Secretaries of the Military Services -Performance Based Logistics*. Feb 13, 2002.
29. ———. 2004a. *Memorandum for Secretaries of the Military Departments, Director, Defense Logistics Agency - Performance Based Logistics (PBL) and the Business Case Analysis (BCA)*. May 20, 2004.
30. ———. 2004b. *Memorandum for Secretaries of the Military Departments- Performance Based Logistics, Purchasing Using Performance Based Criteria*. August 16, 2004.
31. Weir, Kenn. 2006. *Interview with Kenn Weir, Program Manager, Performance Based Logistics, Lockheed Martin Maritime Systems & Sensors*.

Acknowledgments

This research was conducted with support from The Naval Postgraduate School.

The authors are also deeply indebted to Jeff Heron, Performance Based Logistics Policy Director Logistics and Industrial Operations Resources and Policy, Naval Air Systems Command; Joseph Grosson, Managing Director, Enterprise Logistics Technology Office, Lockheed Martin; and Kenneth Weir, Program Manager, Performance Based Logistics, Lockheed Martin Maritime Systems & Sensors; for their cooperation, without which this research would not have been possible.

Special thanks go to Ankur Huria and Carmen Zapata; both were graduate assistants at the Center for Public Policy and Private Enterprise at the University of Maryland's School of Public Policy. They assisted in the research and editing of this report. Finally, we want to thank our coworker Caroline Dawn Pulliam for her assistance with the planning and coordination of this study.

About the Authors

The Honorable Jacques S. Gansler, former Under Secretary of Defense for Acquisition, Technology, and Logistics, is the University of Maryland's Vice President for Research and the Roger C. Lipitz Chair in Public Policy and Private Enterprise. As the third-ranking civilian at the Pentagon from 1997 to 2001, Professor Gansler was responsible for all research and development, acquisition reform, logistics, advance technology, environmental security, defense industry, and numerous other security programs. Before joining the Clinton Administration, Dr. Gansler held a variety of positions in government and the private sector, including Deputy Assistant Secretary of Defense (Material Acquisition), assistant director of defense research and engineering (electronics), executive vice president at TASC, vice president of ITT, and engineering and management positions with Singer and Raytheon Corporations. Throughout his career, Dr. Gansler has written, published, and taught on subjects related to his work. He is a member of the National Academy of Engineering and a Fellow of the National Academy of Public Administration. Additionally, he is the Glenn L. Martin Institute Fellow of Engineering at the A. James Clarke School of Engineering, an Affiliate Faculty member at the Robert H. Smith School of Business and a Senior Fellow at the James MacGregor Burns Academy of Leadership (all at the University of Maryland). For 2003 – 2004, he served as Interim Dean of the School of Public Policy.

William Lucyshyn is the Director of Research and a Senior Research Scholar at the Center for Public Policy and Private Enterprise in the School of Public Policy at the University of Maryland. In this position, he directs and conducts research that addresses complex public policy problems in an effort to speed improvements in the management and delivery of public services. During the past few years, he has written extensively on federal government initiatives, such as outsourcing, privatization, and competitive sourcing, to make government more market-based. Previously, Mr. Lucyshyn served as the principal technical advisor to the Director, DARPA, and the Under Secretary of Defense (Acquisition, Technology, and Logistics), on the identification, selection, research, development, and prototype production of advanced technology projects. Prior to this appointment, Mr. Lucyshyn completed a 25-year career in the U.S. Air Force serving various operations, staff, and acquisition positions. He was certified Level III, as an Acquisition Professional in Program Management in 1994.



ACQUISITION RESEARCH PROGRAM
GRADUATE SCHOOL OF BUSINESS & PUBLIC POLICY
NAVAL POSTGRADUATE SCHOOL
555 DYER ROAD, INGERSOLL HALL
MONTEREY, CALIFORNIA 93943

www.acquisitionresearch.org