Office of the Deputy Assistant Secretary of Defense (Materiel Readiness)

Proof Point Project

A Study to Determine the Impact of Performance Based Logistics (PBL) on Life Cycle Costs

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Executive Summary

The Assistant Secretary of Defense (Logistics & Materiel Readiness) chartered this initiative to provide conclusive evidence regarding the impact of Performance Based Logistics (PBL) on the life cycle cost of sustaining Department of Defense (DoD) weapon systems, subsystems, and major components when compared to non-PBL sustainment arrangements.

Background

In the late 1990s, equipment availability for mission tasking, reliability, and maintainability were generally considered to be weak to poor across DoD. Furthermore, the life cycle cost to sustain equipment was high and out of the Department's control. To address these issues, in 2001 the DoD identified PBL as the preferred equipment sustainment strategy.[1] The business theory supporting PBL suggested that acquiring "performance" (outcomes) rather than materiel, maintenance and/or repair services (inputs) would drive down overall program risk, more effectively manage risk across the defense industrial base, improve reliability and maintainability, and drive down life cycle costs.

Ten years later, there is widespread (but not universal) agreement that equipment maintained under PBL arrangements experience better availability for mission tasking, better reliability, and better maintainability than equipment repaired under transactional arrangements. However, disagreement exists regarding the affordability of the improved performance. PBL proponents assert that overall weapon system sustainment, including life cycle costs, has improved. Critics contend that PBL's benefits and costs are limited or indeterminable, savings are not passed on to the government, that PBLs stifle competition, DoD flexibility is limited due to contract lengths, and that PBLs outsource logistics and, therefore, degrade organic DoD capabilities.

Neither critics nor proponents possessed the rigorous, fact-based analyses necessary to substantiate their position. The absence of conclusive evidence concerning the impact of PBLs on life cycle cost allowed this debate to continue without resolution. In turn, the ongoing debate fueled speculation and hesitancy regarding the future of sustainment practices among DoD activities responsible for equipment sustainment. As expected in this environment, the way forward for Departmental sustainment remained an unanswered question.

This report provides conclusive evidence regarding the impact of PBLs on life cycle cost, while also addressing critic's non-cost concerns listed above. This report provides four tiers of evidence to support its conclusions:

Empirical evidence
Statistical point of proof with a defined level of confidence
Compelling evidence
Preponderance of evidence

[1] DoDI 5000.02: Operation of the Defense Acquisition System, Enclosure 2, Procedures

Methodology

The Deloitte[2] team employed a robust, fact-based three tiered methodology to prove or disprove its hypothesis that:

Sustaining weapon systems, subsystems and major components via Performance Based Logistics arrangements delivers improved readiness at reduced life cycle costs when compared to traditional, transactional sustainment arrangements.

First Tier: A "Middle Dive" analysis was conducted on 21 Army, Navy, and Air Force weapon systems, subsystems, and components with varied contract structures to determine what the preponderance of data and facts revealed regarding the impact of PBL arrangements on performance and the cost to sustain equipment. These analyses employed inductive reasoning to draw generalized conclusions from a finite collection of specific observations. The premise of an inductive logical approach is that it indicates probability for the conclusion; that is, it suggests truth but does not ensure it. Specifically, it will tell you that cost per unit of performance went up or down but does not statistically prove the PBL strategy caused this outcome.

Second Tier: A "Financial Deep Dive" analysis was conducted on 6 Army, Navy, and Air Force weapon systems, subsystems, and components with varied contract structures, to provide greater understanding of sustainment cost drivers. A financial accounting approach utilizing the Original Equipment Manufacturer's (OEM) cost structure and the Service's price structure, contract structure, and an in-depth analysis of the negotiation process and OEM's investment strategies were used to support a suggested linkage between the PBL arrangement and a change in price to the Service.

Third Tier: A "Statistical Deep Dive" investigation was conducted on 5 Army, Navy, and Air Force weapon systems, subsystems, and components with varied contract structures, to provide conclusive evidence of the impact of PBLs on the cost to sustain specific equipment. Both an inductive case study approach and a rigorous statistical deductive approach were used.

Across four programs, the Deloitte team employed rigorous statistical research techniques and a case study research strategy to investigate the respective PBLs. The case-based, empirical evidence resulted in a finding that well-structured and executed PBLs deliver improved cost per unit of performance with a high level of validity. These findings emerge by recognizing links between behaviors and outcomes within and across cases.

In a fifth case, a materiel demand/availability and cost prediction model was created using generalized linear modeling approaches. This model was used to support investigations of suggested links between Performance Based Logistics (PBL) strategy and changes in cost. Using generalized Poisson regression techniques, the team developed a full model of expected demand/availability as a function of materiel demand, time, and their interaction. From these models, tests for trends and corresponding estimated effects were produced. The overall cost, based on the average cost was computed as a function of materiel demand/availability. This resulted in a statistically significant cost reduction that was linked to the PBL strategy. The conservative estimates for the effect of PBLs on cost and associated confidence intervals were computed and are provided.

[2] As used in this document, "Deloitte" means Deloitte Consulting LLP, a subsidiary of Deloitte LLP. Please see www.deloitte.com/us/about for a detailed description of the legal structure of Deloitte LLP and its subsidiaries. Certain services may not be available to attest clients under the rules and regulations of public accounting.

Conclusions

PBL arrangements, which adhere to generally recognized PBL tenets[3], reduce DoD cost per unit of performance while simultaneously driving up the absolute levels of system, subsystem, and major component readiness/availability when compared to non-PBL arrangements.

It is important to note that this finding is not conditioned upon rigid adherence to all 20 PBL tenets (refer to Appendix E for a complete list of tenets), exhaustive contract oversight, or contract renegotiation. Complex business strategies that require flawless execution to achieve success are fragile. The consistent ability of PBL arrangements to positively influence cost and performance results with less-than-strict adherence to all generally accepted tenets suggests the strategy is robust.

Adherence to the tenets among systems, subsystems, and components selected for the analyses spanned the spectrum from strong (but none with 100% adherence) to essentially nonexistent. Of the 21 arrangements reviewed, 18 adhered to PBL strategy tenets in some meaningful ways and are considered PBLs. Three of the arrangements did not embrace the tenets in any substantive manner. The weaker results uncovered during the analyses of these three sustainment arrangements bolstered the initiative's overarching conclusion noted above.

Key findings stratified by level of evidence supporting the conclusions:

Empirical evidence:

1. 12 of 14 PBLs with cost reduction incentives embedded in the contractual arrangement, delivered price-to-Service reductions over the life of the PBL.
2. 17 of 18 PBLs with targeted performance objectives/performance improvement incentives embedded in the contractual arrangement delivered improved performance over the life of the PBL.

Statistical point of proof with a defined level of confidence:

PBLs have successfully incentivized PBL provider behavior that delivered superior sustainment pricing and performance for systems, subsystems, and components

Compelling evidence:

3. PBLs do work, … when there is substantive program adherence to PBL tenets
   Well-crafted PBL contracts "manufacture competition" by incentivizing companies to compete against internal waste and quality challenges in order to drive up reliability (thereby reducing demand for maintenance), while simultaneously driving down repair process, labor, and material costs.

Preponderance of evidence:

Longer term sustainment contracts that provide assured PBL provider revenue streams and contain well-crafted cost and performance incentives drive predictably positive outcomes for the Services.

[3] Vitasek, K., & Geary, S. (2008). *Performance-Based Logistics: A Contractor's Guide to Life Cycle Product Support Management*. Bellevue, WA and Stoneham, MA: Supply Chain Visions in Collaboration with the University of Tennessee, Knoxville, College of Business Administration.

In Summary

This initiative conclusively answers the question: What is the impact of PBLs on the cost per unit of performance to the Services? In short, well-structured and well-executed PBLs deliver superior performance and price to the Service.

Concerns about PBLs exist beyond cost and performance. Most involve the perception of inflexibility and the more complex nature of PBLs when compared to transactional sustainment. Both are valid concerns. However, the PBL strategy accommodates a wide range of contractual options to address the Service's need for various forms of flexibility. A single PBL arrangement is more complex to plan, source, manage and re-negotiate than a single discreet transactional arrangement, however, a single PBL contractual arrangement is less complex and less risky than establishing numerous, disparate contractual arrangements and then exercising the management synchronization required to sustain a single system using legacy transactional practices. PBLs, therefore, require an organic workforce with different program and acquisition knowledge, skills, and abilities than those associated with legacy transactional sustainment.

The Department's annual sustainment spend is ~$110 billion+. The team's estimate of annual savings that would result from broadly transitioning to PBL sustainment across the DoD ranges from 5-15% of sustainment spend. Furthermore, the upfront marginal investment required to transition to a PBL are minimal since most of the resources will come from the realignment of resources from managing and executing transactional sustainment to orchestrating PBLs.

Finally, even at the very low end of the range of estimated annual savings, this project presents the Department with a compelling rationale to broadly embrace the PBL strategy.

1.0 Introduction

In the late 1990s, prior to the Department directing PBLs as a preferred sustainment strategy, equipment availability for mission tasking, reliability, and maintainability were generally considered weak to poor across the DoD. Furthermore, the cost to sustain equipment throughout its life cycle was high and out of control. To address these issues, in 2001, the Department formally designated PBL as the preferred equipment sustainment strategy.

Performance Based Logistics strategy is: "An outcome-based support strategy that plans and delivers an integrated, affordable, performance solution designed to optimize system readiness and affordability". PBL business theory suggests that acquiring "performance" rather than materiel maintenance and repair services will align the goals of the entire supply chain, which in return will drive down overall program risk, more effectively manage risk across the defense industrial base, improve reliability and maintainability, and drive down life cycle costs, while ultimately improving performance.

Over the course of the past decade, numerous programs have reported significant improvements in cost and/or performance when sustained by a PBL agreement. A number of reviews across the DoD attempted to compare the cost of PBLs with the cost of traditional support strategies. The results were inconclusive and unable to provide definitive evidence that PBLs directly drive down the life cycle cost of a weapon system, subsystem, or component.

Today, the general consensus is that systems maintained under PBL arrangements experience better availability for mission tasking, reliability, supportability, and maintainability than equipment maintained under legacy transactional arrangements. However, the absence of a robust, fact-based and data-driven quantitative analyses, and the lack of in-depth understanding of PBLs have left the question of the impact on cost up for debate. PBL proponents claim that every facet of weapon system sustainment, including life cycle costs, has improved. Critics contend that PBLs stifle competition, that savings are not passed on to the government, that DoD flexibility is limited due to PBL contract lengths, that PBL benefits and costs are limited/indeterminable, and that PBLs outsource logistics and, therefore, degrade organic DoD sustainment capabilities.

The ongoing debate has fueled speculation and hesitancy regarding the future of sustainment practices within DoD activities responsible for equipment sustainment and the DoD and both commercial entities that provide PBL and/or transactional sustainment activities. An estimated 70% of weapons systems life cycle costs are in product support functions — not in research, development, test, evaluation, and system acquisition. It is critical to objectively assess the performance of outcome-based versus transactional strategies and determine the most cost-effective approach to sustaining systems in product support.

The Deloitte[4] team has been chartered to comprehensively review PBL program performance and assess the impact of PBLs across a broad spectrum of systems. This report provides evidence regarding the impact of PBLs on life cycle cost. The authors recognize the wide range of individuals interested in the findings of this report, therefore, a summary of each section's objectives are listed below to guide through this narrative report:

[4] As used in this document, "Deloitte" means Deloitte Consulting LLP, a subsidiary of Deloitte LLP. Please see www.deloitte.com/us/about for a detailed description of the legal structure of Deloitte LLP and its subsidiaries. Certain services may not be available to attest clients under the rules and regulations of public accounting.

2.0 Business Theory Underlying Performance Based Logistics Strategy

In traditional transactional sustainment arrangements, when equipment fails or is overhauled, sustainment providers charge the Services for repair or replacement on a per-transaction basis. Traditional sustainment providers' revenue increases in proportion to an increase in equipment failure — creating a fundamental misalignment of sustainment providers' and Services' interests. This misalignment holds true if the sustainment provider is an organic DoD activity or commercial company.

2.1 Basics of Performance Based Logistics Theory

PBL business theory suggests that buying performance (as defined by the Services) rather than contracting on a fail and fix or fail and buy basis aligns the military Services' and PBL providers' interests in a manner that, drives down the cost and improves performance. Inherent in PBL theory are the overall reduction of financial and mission performance risk and the transfer of some of that risk from the military Service to the PBL provider.

By way of example, for a component level PBL, where the performance metric is material availability, the Service pays a single fixed price over the life of the contract in return for a specified level of component availability. In this situation, the sustainment provider no longer increases profit or net operating revenue from an increase in the number of equipment failures, but rather from an increase in equipment reliability and the resultant decrease in the requirement for component repair or replacement. The PBL provider's financial success is tied to the system's reliability and reduced maintenance costs, thereby aligning the Service's and sustainment provider's objective. This opportunity for increased profits through PBLs incentivizes sustainment providers to improve reliability and decrease the cost to maintain material over the contract life. At contract renegotiation, the government is positioned to realize some of the cost savings achieved by the sustainment provider by awarding the follow-on contract at a lower price.

PBLs mitigate mission risk by incentivizing sustainment providers to invest in areas, such as reliability, maintainability, cycle time, lean, and supply chain optimization. PBLs reduce and spread financial risk by creating a contractual agreement wherein the sustainment provider is committed to delivering a specified level of performance over the life of the contract, regardless of their cost to perform sustainment functions.

By contracting for performance outcomes, rather than material and repair activities, PBLs fundamentally alter relationships and sustainment providers' incentives resulting in increased performance at a decreased price. This change in relationships and incentives creates an increase in efficiencies in the defense material sustainment environment.

2.2 PBL Theory: The Right Strategy for the DoD Sustainment Environment?

2.2.1 Sustainment Environment

The defense sustainment environment is largely a monopolistic and oligopolistic space, with true competition being the exception to the rule. The complexity and criticality of the systems and the product support require significant innovation and investment. This creates barriers for new companies to enter into the market space, which in turn results in significant supplier power for the existing entities.

2.2.2 Profit

Regardless of the nature of the market space in which a company operates, it is incentivized by the opportunity to increase profits by maximizing the spread between its revenue and cost. Sustainment

providers' investment decisions are guided by the opportunity to realize a profit directly related to the investment in a reasonable period of time.

2.2.3 Traditional sustainment

Under non-PBL transactional sustainment arrangements, companies have little incentive to reduce their costs or optimize equipment reliability. They are incentivized to invest primarily in research and development because they gain the most revenue from the most technically advanced product. When a part breaks often the only entity that can supply the replacement is the OEM, leaving the government to rely solely upon the OEM. OEMs are not incentivized to make strategic investments in product sustainment because they increase profit with increased demand for parts. The supplier is the only entity in the supply chain that does not participate in increasing efficiencies in the product sustainment.

Then how can the government increase buyer power and promote innovation in both complex systems and the product support to ultimately increase efficiencies? The answer is aligning both the customer's and supplier's objectives to drive strategic investments, promote innovation, catalyze strategic partnership, and manufacture competition, which all increase efficiencies.

The overarching goals of the PBL strategy is to optimize the supply chain, reduce total ownership cost, and improve readiness for weapons systems, and commodities by eliminating inefficiencies, reducing the demand for product support services, and aligning incentives.

Traditional program management approaches emphasize conformance and compliance, while performance-based approaches incentivize entrepreneurial behavior and innovation. In order to understand why PBLs stimulate innovation and manufacture competition to increase efficiencies, one must understand what drives companies' strategic decisions in the defense industry.

Rather than a market exhibiting perfect competition, the defense markets in the United States have evolved to oligopoly, or in some cases, monopoly. Complex weapons systems are designed, integrated, and sold by few. For example, there are no domestic alternatives to Lockheed Martin for 5th generation fighter aircraft. For military aircraft in general, an oligopoly exists, as choices are limited to entities, such as Lockheed Martin, Boeing, and Northrop Grumman who provide essential equipment with limited direct competition. Figure 1[5] illustrates the concentration of defense spend in a very few companies.

Figure 1: Commercial Company Revenue

Rank	Company	2009 Defense Revenue
1	Lockheed Martin	$42,025,700,000
2	BAE Systems	$33,418,800,000
3	Boeing	$31,932,000,000
4	Northrop Grumman	$30,656,900,000
5	General Dynamics	$25,904,600,000
6	Raytheon Company	$23,139,300,000
7	EADS	$15,013,700,000
8	Finmeccanica	$13,332,100,000

[5] Defense News Top 100 for 2009 – Army Times Publishing Company, Published June 28, 2010

9	L-3 Communications	$13,014,000,000
10	United Technologies	$11,100,000,000

Managing product support for complex weapons system across their life cycles is a portfolio management strategy of considerable magnitude. Trying to balance the complex interactions among readiness, reliability, maintainability, supportability, availability, surge, and Title 10, while delivering an affordable product, is a daunting challenge.

In order to align the objectives of the Services and Providers, one must understand that profit drives the product support provider's strategic decisions. Figure 2[6] identifies profit margins for major U.S. industries. It is worthwhile noting, that aerospace and defense ranks near the bottom of this list.

Figure 2: Industry Ranking of 2008 Profits

Industry Rank	Industry	2008 Profits as % of Revenues
1	Network and Other Communications Equipment	20.4
2	Internet Services and Retailing	19.4
3	Pharmaceuticals	19.3
4	Medical Products and Equipment	16.3
5	Railroads	12.6
6	Financial Data Services	11.7
7	Mining, Crude-Oil production	11.5
8	Securities	10.7
9	Oil and Gas Equipment, Services	10.2
10	Scientific, Photographic, and Control Equipment	9.9
11	Household and Personal Products	8.7
12	Utilities: Gas and Electric	8.7
13	Aerospace and Defense	7.6
14	Food Services	7.1
15	Industrial Machinery	6.9

According to Fortune Magazine, in 2009, the Aerospace and Defense Industry in the United States earned a combined 7.6% profit on revenue, which places it 13th on the list, while 1st on the list, Network and Other Communication Equipment, earned almost three times as much at 20.4% (Table 3). The limited profit opportunity and the oligopolistic environment inherent in the Defense Industry cause providers to strike a conservative posture and limit the amount of investment in areas with an uncertain return. Contract arrangements can shift the provider's strategic investment decisions. Comparing a non-PBL to a PBL arrangement exemplifies this point.

[6] Defense News Top 100 for 2009 – Army Times Publishing Company, Published June 28, 2010

Roughly 70% of life cycle costs reside in sustainment, allowing for significant opportunities to reduce cost when both parties make investments in improvements to the sustainment of a weapon system.

PBL arrangements manufacture this opportunity by holding the provider accountable for the performance of the weapon system over time, tying their profit to the health of the sustainment solution for the system, subsystem, or component. PBLs incentivize suppliers to make strategic investments in innovation and processes that will reduce demands, which directly decrease cost. OEMs improve profit by driving cost out of repair processes, improving supply chain performance, or investing in reliability improvements. These improvements drive up the mean time between maintenance (MTBM), which in a fixed-price environment leads to an improvement in the bottom line for a provider and improved readiness for mission tasking for the military Service.

Industry investment is guided by the profit opportunity and investments are contingent on their ability to reduce costs in follow-on years. The investments are in effect representative of companies competing with themselves and directly attacking their internal cost structure. When successful, the net effect is a larger near-term profit opportunity for the provider which will translate into a lower cost in the long run for the government.

PBLs catalyze strategic partnerships because they create a different competitive dynamic, driving the support providers to compete with themselves in order to secure profits. By making support provider profits contingent on year-over-year cost reductions, two goals are accomplished:

Industry is stimulated to provide investment to reduce costs

Internal competition is manufactured to optimize efficiencies in an oligopolistic environment

2.3 Investigation of Competitive Business Decisions and Beliefs within DoD

A performance-based approach to product support, in theory, converts year-after-year transactional spending into large target pools of cost avoidance. This potential pool of cost avoidance is financial opportunity that can be leveraged with an appropriate acquisition strategy. An outcome-based strategy encourages the suppliers to make initial investments that reduce total life cycle costs, and allows the Service to reap a return by harvesting cost avoidance downstream.

In order to have the opportunity to earn back any investment, the investor needs an adequate base period of performance (PoP), frequently 3–5 years, and in some cases, longer. The magnitude of investment — and consequently, the appropriate PoP — depends on the scope of the individual program, as well as the operational environment of the weapon system. Because the PBL strategy often includes Firm-Fixed-Price provisions, and industry assumes the risk of the investments actually yielding the expected benefit, the pricing structure often creates the opportunity to earn a higher profit (or greater loss), than is generally available in a traditional cost plus arrangement.

A PBL acquisition strategy must be formulated to induce appropriate behaviors within this trade space. This means those charged with the responsibility to craft the strategy, as well as those with the responsibility for fulfilling the requirement, must have a sound grasp of the business model.

2.3.1 Study Overview

Using a survey approach, the research team sought to explore the interaction among price, term, and acquisition strategy for product support, and to the extent possible, stratify those perspectives, contrasting the behaviors and beliefs of government with the behaviors and beliefs of industry.

2.3.2 Study Findings

In our research, we found that for industry:

- Industry's risk-adjusted profit expectations are reasonable.
- When presented a short term (e.g., single-year contract), industry is less likely to invest.
- Industry resistance to investment of their own funds can be overcome by presenting industry with longer-term contracts.
- Industry is willing to put their investment funds at risk, but they require the opportunity to earn it back. Priced options appear to induce positive behavior.
- This suggests an opportunity to grow collaboration to induce improved performance and affordability.
- Contract periods of performance that are "too long" seem to dissuade industry from investing, likely driven by the influence of the unknown (leading to higher risk) with lengthier horizons.

We found government managers apply a different perspective, leading to different choices:

- Government tends to invest with little regard to recouping the investment within the contract term. While this may make sense within the DoD, contractors will not invest their money without an opportunity to earn return.
- Government managers do not adequately price risk. This suggests to potential bidders that risk and investment are unlikely to be recognized or rewarded by their government customer, and they plan accordingly.
- Government managers have very low estimations of reasonable profit, ranging from operating at a loss to a maximum of 4%, depending on the situation.
- In side-by-side comparisons of proposed margin for the same business proposal, government margin expectations are between 1.8% and 4.6% lower than their industry peers, with an average gap of 3%.
- For the most part, across all three scenarios, the government respondents tended to have significantly lower profit expectations than industry, and, in fact, a very large number of government managers proposed a negative profit margin.

Insight can only come from understanding, and it appears that fundamental misunderstandings of sound business practice exist. Even in a situation where the acquisition strategy is clearly driven away from the agreed upon factors, government still expects the contractor to behave like a valued strategic partner. In one-year contracts with no option periods the government respondents still expected industry to invest. Yet contractor investment is implicitly associated with a strategic, long-term relationship. Government wants industry to behave like a strategic partner, even when industry is being treated as a commodity. Short term limited volume contracts carry with them lower probability of industry investment, but the government community does not make that linkage. Further, short term, limited volume contracts carry additional risk for providers, which the government does not often recognize.

2.3.3 Implications

In order to more effectively collaborate and successfully integrate, all parties in the defense industrial base, from both the government and industry, must share a common perspective — including the underlying business model — on product support strategies. What acquisition approaches stimulate investment? What are the implications of stimulating more competition as an acquisition strategy? How does a longer period of performance affect investment decisions? How can these factors be integrated in the acquisition strategy to align and synchronize operational, acquisition, and sustainment communities working together to deliver required and affordable warfighter outcomes?

Answers to these questions must be embedded in sustainment Business Case Analysis (BCA). Determination of best value support strategies relies on a BCA process that has been consistently criticized by internal and external reports, citing reliance on immature data, inconsistent application, and overreliance on a one-size-fits-all analytic approach that fails to acknowledge differences in criteria, such as life cycle phase, level of planned product support, and availability of credible data. Acquisition and logistics workforce assessments have reported weaknesses in both communities, citing shortcomings in competencies and the culture needed to translate warfighter performance requirements into cost-effective product support spanning the weapon system life cycle.

The responsibility for the development of product support strategy is clearly in the hands of the government. While it is true that the government is not a profit-making business, product support decisions must be evaluated and executed from a business perspective. In order to define an executable acquisition strategy, both the government and industry must have a shared and accurate understanding of market dynamics and profit requirements.

3.0 Evolution of Performance Based Logistics in the DoD

This section discusses the emergence, execution, and evolution of Performance Based Logistics in the defense industry since the PBL strategy was introduced 11 years ago.

3.1 DoD Readiness Environment Pre-PBL (1990's)

At the end of the Cold War, DoD reduced the budget for product support as one mechanism to achieve the peace dividend. A snowball of negative events ensued, which Dr. Gansler[7] described as the "Death Spiral". With the decrease in DoD budgets, the Research & Development (R&D) budget decreased substantially. With less development, the government continued to use aging assets, whose readiness continued to decline over time. Naturally, the maintenance required increased. In order to support the increasing Operations and Support budget requirement, the DoD sought to offset the shortfall by cutting the Acquisition/R&D budget more, ultimately resulting in a continuous downward spiral in weapons system availability and reliability that continued for almost a decade. Furthermore, the rapid technology evolution occurring in the 1990s widened the government's modernization gap.

Jacques Gansler, Under Secretary of Defense for Acquisition, Technology, and Logistics, from 1997 to 2001 described the situation:

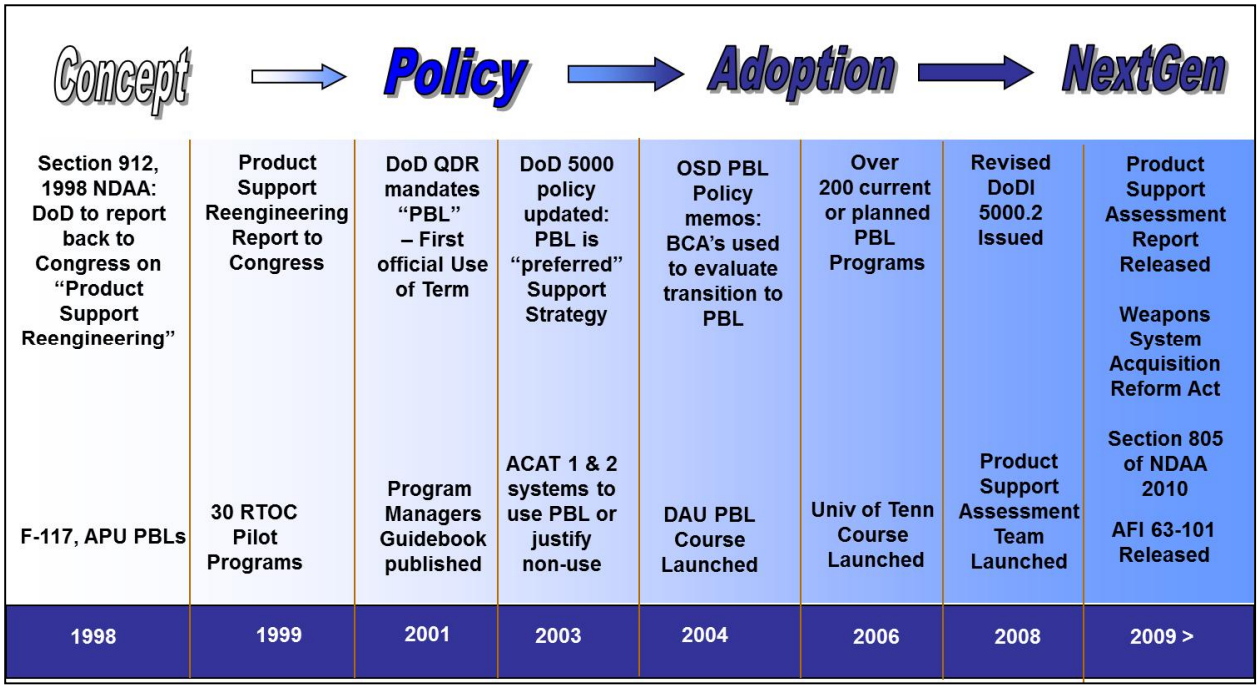
> "…to reverse this trend—with current short-term needs consuming an ever-increasing 'share of the pie' at the expense of long-term military capability—will be extremely difficult. I have called this situation a 'death spiral'; and, in fact, we will come to that…if we do not act decisively, now. It will require significant cultural change, a sense of urgency, and difficult program funding decisions. The result may be that we will have to put some sacred cows out to pasture—not just keep trying to milk them."

The government recognized a need for change and, in 1998, Congress mandated a report on "Product Support Reengineering". Developed in response to the spirals of decreasing readiness and increasing costs in the 1990s, PBL strategies were an attempt to reverse this trend.

[7] Dr. Jacques Gansler, Under Secretary of Defense for Acquisition, Technology, and Logistics, from 1997 to 2001.

3.2 Executing the PBL Strategy (1998-2011)

Figure 3: PBL Evolution



Congress catalyzed the movement away from traditional approaches to Product Support when they directed the "Product Support Reengineering" report in 1998. The DoD completed and submitted this report in 1999.

> "This report on Product Support for the 21st Century charts some of the important next steps of continued acquisition and logistics reform. It identifies how DoD will capitalize and expand on best practices—commercial and government—to transform weapon system support processes to meet the urgent operational needs of our warfighters. It emphasizes competition as a continuous life cycle ingredient to provide best value support and mandates continuous technology refreshment as an effective method to lower weapon system total ownership costs, while at the same time, satisfying the warfighters' operational and readiness requirements. This document is more than a report. It is an implementation strategy, built on the Section 912(c)."

In 1999, DoD established a goal that directed each military department to reduce the operation and support costs of its fielded systems by 20% by the year 2005. The areas identified for potential cost savings were reducing demand on the supply chain by improving the reliability and maintainability of equipment, reducing supply chain response time, and increasing competitive sourcing of product support. Also, in 1999, the Under Secretary of Defense (Acquisition and Technology) directed the Services to use an existing pilot program containing 30 weapon systems to demonstrate the type of cost savings depicted in the fiscal years 2001-2005 Defense Planning Guidance. Some of the 30 pilot programs involved performance-type arrangements that the services subsequently converted to, or designated as, PBL arrangements. This laid the foundation for product support policy, guidance, and practice of the last decade, and it spawned the development of a PBL business model.

In November 2001, DoD identified PBL as the preferred weapons system support strategy in the QDR.14 In May 2003, DoD further strengthened this emphasis on PBL by stating in a DOD policy directive that acquisition managers shall use performance-based strategies for sustaining products and services whenever feasible, and PBL strategies shall optimize total system availability, while minimizing cost and

the logistics footprint.[8] In 2004, the Deputy Secretary of Defense issued a memo directing each Service to submit an aggressive PBL implementation plan for FY 2006-2009, and by 2006, over 200 current or planned PBL programs were identified.[9]

Much as the Product Support Reengineering Report of 1999 laid out an implementation plan for the first generation of outcome-based product support, the 2009 DoD Weapon System Acquisition Reform Product Support Assessment Report lays out the implementation plan for the next generation of product support on the legislative catalysts provided by Congress in 2009. According to the report, in spite of "endemic structural issues, there are rich opportunities for change. The military, political, and economic stars are aligned for fundamental reform of product support as part of acquisition reform, providing a unique window of opportunity in which fundamental reforms are not only possible, but required."

Similar to 1999, product sustainment strategy is at a crossroads. However, the challenge of a decade ago was performance, while the contemporary challenge is affordability. The 2009 DoD Weapon System Acquisition Reform Product Support Assessment Report continues and describes the need: "The challenges of affordability constraints, the need to upgrade equipment and infrastructure, and a continuing, persistent operations tempo prescribed a clear need for DoD implementation of an integrated plan to address product support across the Defense enterprise. Successful change in weapon system product support will be demonstrable by reducing costs, while maintaining equal or greater equipment readiness support for key warfighting capabilities."

4.0 PBL Strategy at the Cross Roads

The current economic situation will eventually drive defense budgets for operations and sustainment significantly lower giving rise to questions about how the Services will fund product support in the future to balance recapitalization and modernization. The Department of Defense has been here before. In 1990, the answer was to cut the research and development budget causing cascading events leading to low reliability and maintainability, which drove an increase in cost. The DoD faced the issue of declining performance and the requirement to spend an ever increasing share of the Department's budget on sustainment. Part of the answer in 1998 was Performance Based Logistics, a business theory designed purchase outcomes instead of repair services in order to reverse the trend of low performance while maintaining costs. The performance challenges of the late 90's have been replaced with the affordability challenges of the present day.

While there is general consensus that outcome-based strategies lead to improved performance, the economics of the PBL strategy is less clear cut. Prior to this initiative, there have been no analyses completed that provide conclusive evidence of the impact of PBLs on life cycle costs.

Over the course of the past decade, a host of programs have publicly reported significant improvements in cost or performance attributed to the implementation of an outcome-based strategy as outlined in Figures 4 and 5. The evidence is compelling. Performance has improved, and the preponderance of the evidence indicates costs have reduced as well. However, no assessment validates this evidence.

[8] GAO Defense Logistics: Improved Analysis and Cost Data Needed to Evaluate the Cost-Effectiveness of Performance-Based Logistics, p 8-9

[9] Performance-Based Logistics (PBL) Partnerships: Assessment Of Implementation Methodologies For Selected ACAT 1 & 2 Systems, page iii

Figure 4: PBL Performance Evidence Pre-Project[10]

Program	Availability Benefits	Program	Availability Benefits
F/A-18 FIRST	98% RFT	P-3 APS-137	+ 45%
F/A-18 SIMS	+ 32%	TOW-ITAS	99% Availability
H-60 FLIR	+ 67%	RC-12 FW A/C	+ 90%
Navy Tires	+ 17%	HIMARS	98.7% Availability
AEGIS FCS	+ 30%	C-12 FW A/C	+ 90%
F-404 Engine	+ 46%	TAIS	+ 98%
F-404 Eng MFC	+ 75%	Apache Sensors	+ 95%
T-700 Engine	+ 35%	AH-64D Components	95% Availability
CIWS	+ 7%	F414 Engine Compon	97% Availability
H-53 Compnts	+ 48%	H-60 FLIR	+ 67%
H-60 Tip-to-Tail	+ 14%	CAINS Inertial NS	99% Availability
H-46 Compnts	+ 12%	AN/ALQ-126B	99.9% Availability
Nimrod (UK)	+ 40%	CASS	97% Availability
AN/ALQ-126B	+ 50%	KC/HC-130J	90.5% Availability
LANTRIN	+ 17%	HH-65	99% Avail, 90% MC
EA-6B Hydraul	+ 48%	MH-60T	99% Avail, 90% MC
APUs/ H-53 PH1	+ 48%	HC-144A	99% Avail, 90% MC
APUs/ H-53	+ 26%	HU-25	99% Avail, 90% MC
Mk41 VLS	+ 7%	C-23 FW A/C	+ 95%
Seasparrow	+ 14%	UC-35 A/C	+ 90%
Navy Cockpit	+ 57%	C-36 FW A/C	+ 97%
ALR-67(v)3	98% Availability	C-20 FW A/C	+ 96%
Sentinel	95% Availability	C-26 FW A/C	+ 95%
Shadow	96% + OR	EO 5 FW A/C	+ 94%
Javelin	98% + OR	HC-144A	99% Availability
HH-65	99% Availability	HU-25	99% Availability
KC/HC-C130J	99% Availability	MH-60T	99% Availability

[10] OSD Power Point: Good For Warfighter: Performance Up Costs Down

Figure 5: Cost Evidence Pre-Project[11]

Program	Cycle Time Benefits	Program	Total Cost Benefits
F/A-18 FIRST	- 74% LRT; - J533% RTAT	ALR-67(v)3	$62.7M (40%)
F/A-18 SIMS	- 84% LRT; -100% B/O's	F/A-18 FIRST	$688M
H-60 Avionics	- 84% LRT	Sentinel	$139M
Navy Tires	- 92% LRT; - 100% B/O's	Apache Sensors	$123M
Navy APUs	- 92% LRT	AN/AAS-44	$31M (25.2%)
LANTRIN	- 90% LRT	APUs	$10M (20.5%)
AEGIS FCS	-10% B/O's	F405 Engine	$24M (17.2%)
T-700	- 74% RTAT; - 100% B/O's	Navy Cockpit	$71M (16.5%)
AH-64 Apache	- 35% RTAT	LANTRIN	$9.6M (14.6%)
Chinook	Reduced RTAT	F-404 Engine	$79M (13.4%)
Chinook Blades	Improved LRT	Patriot	$1M (13.1%)
T-26T -28 APU	Reduced RTAT	AN/ALQ-126B	$2.1M
T-55 Engine	Reduced RTAT	AH-64D Apache	$100M
CIWS	- 97% B/O's	HIMARS	$18.6M (24.5%)
CAINS Inertial NS	- 100% B/O's	T-45	$61M
F-404 Engine	- 25% RTAT; - 90% B/O's	ARC-210	$7.6M
Patriot	- 100% B/O's		
H-60 Tip-to-Tail	- 85% LRT	Program	Annual Cost Benefits
Seasparrow	- 87% B/O's	CASS CSP	$2.9M
KC/HC-C130J	-75% LRT	TOW-ITAS	$6.3M (34.5%)
HH-65	-75% LRT	Navy Tires	$46M (15%)
Shadow	-75% LRT	TAIS	$0.01M
HC-144A	-75% LRT	KC/HC 130J	$10.5M
HU-25	-75% LRT		
Navy Cockpit	- 100% B/O's		

[11] OSD Power Point: Good for Warfighter: Performance Up Costs Down

4.1 Lack of Fact-Based Analysis on Performance Based Logistics' Impact on Costs

Over the past decade, a number of reviews across the DoD attempted to compare the cost of outcome-based product support strategies with the cost of traditional or legacy product support. In these published studies, the teams conducting the analysis were challenged to offer a comparative analysis between outcome-based and traditional product support strategies. Their results were largely inconclusive.

> ". . . DOD has implemented PBL arrangements without the benefit of sound analyses that ensure that the chosen approach will provide the most cost-effective support option. While one of DOD's goals in moving toward the use of PBL arrangements was to reduce weapon system support costs, the ability of these arrangements to reduce costs remains unclear 7 years after DOD first identified PBL as the preferred weapon system support strategy. Many DOD program offices that implemented PBL arrangements have limited cost data, and various other factors — such as the lack of business case analyses — further limit an evaluation of the costs of this support strategy. Available data from the programs GAO [Government Accountability Office] reviewed indicated mixed results. Although a few programs in GAO's sample provided evidence of some cost reductions, GAO's analysis of the only two systems in its sample that are managed using both a PBL arrangement and a more traditional, non-PBL arrangement indicated that in both cases, the PBL arrangement had higher costs. Also, GAO found that certain characteristics of DOD's PBL arrangements — contract length, funding stability, ownership of inventory, and the lack of cost metrics and effective incentives — could limit the ability of an incentive for contractors to reduce support costs."[12]

However, the appendix supporting this GAO report points out that the Performance Based Logistics (PBL) arrangements they reviewed constitute a nonprobability sample and the results "are not generalizable" to the population of PBL arrangements. This illustrates the difficulty for any entity conducting reviews that attempt to compare the outcomes of traditional sustainment to those of outcome-based product support strategy and provide general conclusions. Each program is unique in some way, which inhibited the ability to provide meaningful comparisons.

Outcome-based product support arrangements are generally recognized to deliver improved system performance when compared with traditional DoD product support arrangements. However, the absence of robust, fact-based and data-driven quantitative analyses that compare the costs of these arrangements with traditional transactional support arrangements has left the question of cost-effectiveness open to speculation.[13] This uncertainty regarding cost-effectiveness leaves the Department without the hard facts required to create an informed plan for the future of DoD product support. In the words of one academic researcher, "While the managerial and analytical arguments for PBC [Performance-Based Contracts] are pervasive, empirical research to support these conclusions is currently nonexistent."[14]

4.2 Opposing Views of the Impact of PBLs on Sustainment Costs

The absence of data-driven, fact-based documentation of PBLs' impact on weapon system life cycle cost has resulted in historically difficult evaluation of PBL utility, leading to both positive and negative assertions regarding the PBL strategy. Today, less than 5% of product support strategies within the DoD use a performance-based approach.[15] With traditional transaction-based sustainment models accounting for an estimated 95% of programs, it is difficult to get a realistic picture of how PBL could benefit the DoD. Moreover, while there is solid evidence of the impact of an outcome-based approach on performance, the case is less clear on affordability. At the same time, competition advocates fear that

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[12] Defense Logistics: Improved Analysis and Cost Data Needed to Evaluate the Cost-effectiveness of Performance Based Logistics GAO-09-41 December 19, 2008

[13] Similar questions can also arise regarding other purported benefits (e.g., reliability and availability) of outcome-based arrangements.

[14] "Impact of Performance-Based Contracting Product Reliability: An Empirical Analysis, p. 2

[15] Flint, P. Balancing Act. *Air Trnaport World, 44(1)*, 2007

long-term arrangements with suppliers inhibit competition and lead to less than advantageous prices for the government. This debate continues between proponents and critics of the PBL sustainment approach, neither group armed with data-driven facts to support their arguments.

4.3 Project Chartered to Close the Fact Gaps

Anecdotally, a case can be made that the concepts and theories used to craft outcome-based product support arrangements should result in a cost-effective life cycle management approach in comparison to traditional product support. However, when making multimillion dollar decisions that impact the life cycle cost-effectiveness of a portfolio of programs or individual weapon systems, decision makers require more than anecdotal evidence in deciding on the appropriate product support strategy. The product support community needs rigorous empirical analysis that supports fact-based decision making to identify the effectiveness of product support strategies.

Cost-effectiveness encompasses the dual notions of cost and performance, which ultimately encompasses value for taxpayers. Until now, there was little empirical research to either confirm or refute the value proposition of an outcome-based strategy across a spectrum of programs in DoD. The OSD chartered the team to determine the impact of PBLs on weapon system life cycle cost, using a robust statistical methodology.

The team comprehensively reviewed PBL program performance and provided an objective assessment of the impact of PBL across a portfolio of diverse PBL arrangements. While no two programs are the same, there was sufficient commonality in product support methodologies and metrics to develop a reasonable evaluation framework for assessing the impact of PBL on the life cycle costs and performance of the selected programs.

The hypothesis was that sustaining material via Performance Based Logistics arrangements delivers improved readiness at reduced life cycle costs. That is, the cost per unit of performance to the Department of Defense is lower when a system, subsystem, or component is maintained via a PBL agreement rather than through traditional, transactional maintenance arrangements.

5.0 Methodology

This study completed a rigorous review of the value proposition associated with PBL strategies. It should inform both decision makers and managers as they build product support plans and must select, develop, and support the best value strategy.

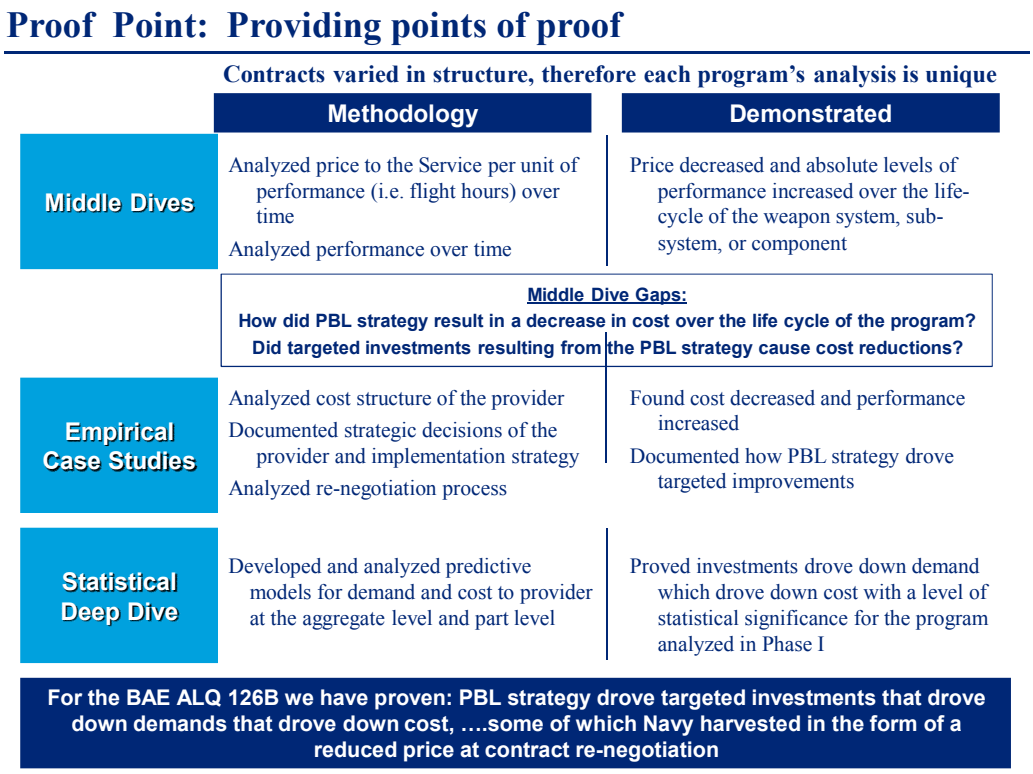
5.1 Hypothesis and Overarching Approach

To answer the question “are PBL arrangement cost-effective and do they promote improved performance,” the team employed a robust, fact-based, three-tiered methodology in two phases to test the hypothesis that:

Sustaining weapon systems, subsystems, and major components via Performance Based Logistics arrangements deliver improved readiness at reduced life cycle costs when compared to traditional, transactional sustainment arrangements.

In this study, we investigate 21 programs utilizing outcome-based strategies — including weapons systems from each of the military Services — to define the cost impacts of performance-based strategies. The rigorous three-tiered methodology includes 21 middle dives, 6 empirical case studies, and 5 statistical deep dives. The approaches are described in the next three sections, 5.2—5.4. An overview of the three-tiered methodology is below.

Figure 6: Methodology



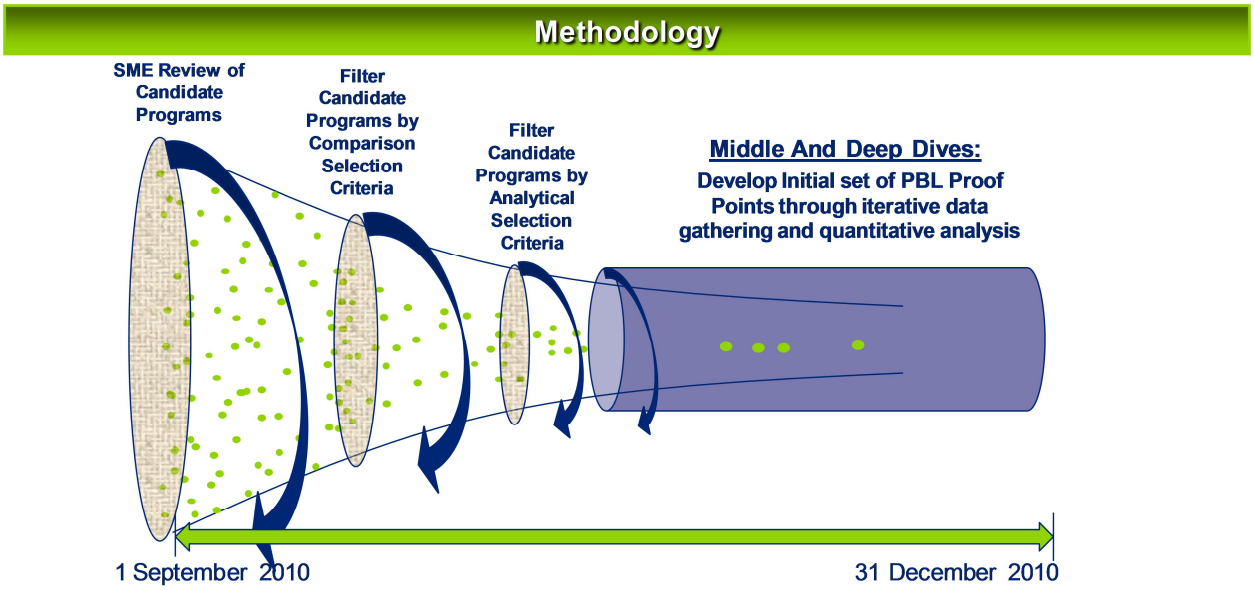
5.2 Selection Process of PBL Programs Analyzed

The study was conducted in two Phases. Phase I was designed to investigate the hypothesis that PBL can work. Phase II explored factors influencing the success of PBL to develop lessons learned to apply in the real world situations. The effort was constrained by time, causing the team to have a limited sample size.

5.2.1 Phase I

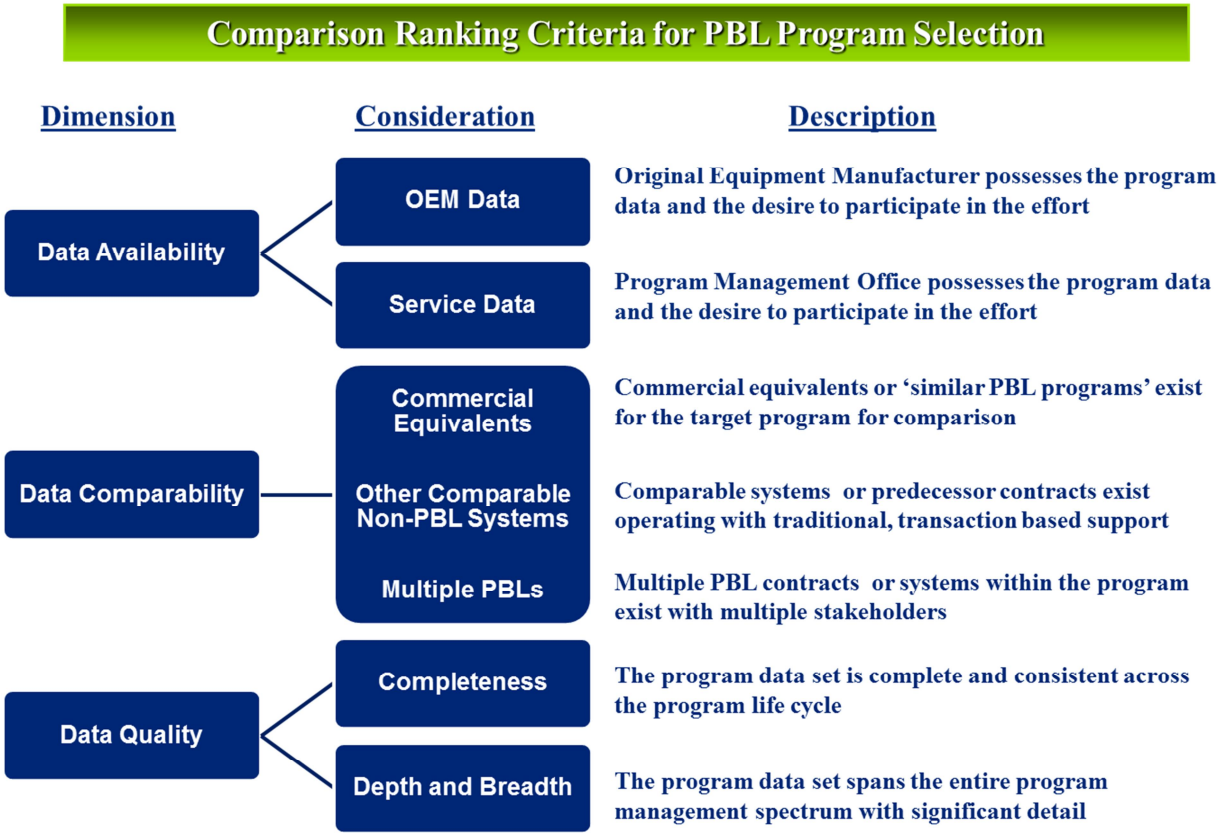
At project launch, the availability of the data and the feasibility of the analysis were unknowns, exacerbated by the time available to execute causing the selection process for Phase I contained bias towards programs what had comparable, available, and high-quality data. Therefore, the SMEs started with a data rich set of programs, a list of PBL Award Winners, and the team approached the selection process through multiple iterative steps, illustrated in the image below.

Figure 7: Selection Process Methodology



At each step of the process, the Subject Mater Experts would take into consideration the dimensions listed below based on their personal knowledge and discussions with other SMEs.

Figure 8: Program Selection Criteria



The finalized list of Phase I PBLs is captured in Figure 9 below.

Figure 9: Phase I Middle List

Middle Dive Programs		
Program	**Provider**	**Service**
Joint STARS	Lockheed Martin	Air Force
ALQ-126B	BAE Systems	Navy
ALR-67	Raytheon	Navy
H-60 FLIR	Raytheon	Navy
F/A-18 Displays	Rockwell Collins	Navy
F404 Engine	General Electric	Navy
AH-64D Apache	Boeing	Army
HIMARS	Lockheed Martin	Army
ITAS	Raytheon	Army
Shadow 200	Textron AAI	Army

Phase I confirmed that a PBL strategy can decrease the life cycle cost of a weapon system and that providing conclusive evidence to support or refute the hypothesis was possible.

5.2.2 Phase II

Phase II's intention was to broaden the analysis and determine in a more generalized way if PBL strategies will drive down the life cycle cost of a weapon system via the same analytical methodology over a larger sample size, but also apply scientific rigor to uncover lessons learned.

Phase II's built upon the data set and analyses the team already completed. Phase II took a more rigorous selection processes to decrease the selection bias, and used a Delphi Method to develop a set number of programs. Subject Mater Experts (SMEs) created a ranked list of 34 different candidate programs. To counter-balance the selection bias in Phase I, the team intentionally selected programs with a reputation of not performing as strongly as the award winners, as well as a balanced list that equally spanned all of the services, and other characteristics, such as contract type. The next step in the process was to have other SMEs outside of our team rank them from one to thirty four on criteria based on the same criteria the team took to selecting the 34 programs. Based on these rankings, the team broke them out by service and selected the top ranking under each service. This became the base list for all analysis.

Then, based on Services requests, other programs were added to the candidate list for financial and statistical deep dives.

Figure 10: Phase II Middle Dive Programs

Middle Dive Programs		
Program	**Provider**	**Service**
RFTLTS	BAE Systems	Air Force
C-17	Boeing	Air Force
F-22	Lockheed Martin	Air Force
Army Common Ground Station	Organic	Army
F-18/ FIRST	Boeing	Navy
H-60 Tip to Tail	MSCO	Navy
Phalanx	Raytheon	Navy
Tunner Loader	DRS Technologies	Air Force
ARC-210	Rockwell Collins	Across Services
Stryker	General Dynamics	Army
Javelin	Raytheon/Lockheed Martin	Army

The Phase I and Phase II middle dive list were filtered down to a finalized list for the Phase II deep dives based on data collection process, conversations with the OEMs during the financial deep dive data calls, and the assessed availability of the data required to complete the analysis.

Figure 11: Phase II Deep Dive Programs

Deep Dives		
Program	**Provider**	**Service**
F-22	Lockheed Martin	Air Force
RFTLTS	BAE Systems	Air Force
HIMARS	Lockheed Martin	Army
F-18/ FIRST	Boeing	Navy
H-60 Tip to Tail	MSCO	Navy

The team then collected data for the middle dives. Financial deep dive analysis required buy in on the side of the PBL provider, which narrowed down our deep dive candidate list one step further. Because of the rigorous nature of the statistical deep dive, the team gathered data for five programs.

5.3 Middle Dive Methodology

The sustainment strategy is unique for each system, so in order to provide a framework for cross-program analysis, a structured methodology is used. The middle dive analysis contained three elements: the critical drivers (Program Basics), Cost per Unit of Performance (Cost Calculation), and Performance.

5.3.1 Program Basics

Critical enablers to outcome-based strategies — contract length, contract type, PBL level (system, subsystem, component), key performance metrics (KPIs), and such — can impact the strength of an incentive's effect on providers desire to improve performance and reduce support costs. Therefore, the basis for the cost calculation and performance was the program basics. For each program, the team provides:

- Program definition
- Current population size
- PBL coverage — Categorization of what the support covered which was defined based on the award submission criteria, which says:
    - System Level: Weapon Systems Platforms and/or System of Systems programs.
    - Subsystem Level: Weapon subsystems and/or major subassemblies.
    - Component Level: All other products, components and services.
- PBL initiated — Year the first PBL was initiated
- Contract type — Firm-Fixed-Price versus Cost Plus and whether or not there is built-in incentive fees
- Contract number — Number of contracts that have been awarded under PBL
- Contract coverage — Dates of the contracts
- Pre-PBL support? — Was the program supported organically before the current PBL arrangement?
- Key metrics — List of the key performance metrics that will be illustrated in the performance analysis

5.3.2 Cost Calculation

For the cost per unit of performance analysis, the price to the Service (or in other words, the price the OEM received for the service) was normalized by a "usage" variable. The typical variable utilized was flight hours, however, it was contingent on the contract, program management of metrics, and the system level being supported. A more detailed explanation of the cost calculation and analysis is captured in each program's respective quantitative results section in 6.2. A linear regression was applied to the cost analysis to determine the trend of the cost per unit of performance.

Limitations exist within the middle dive cost calculation with respect to both the price variable and normalization factor. The cost variable was limited to the price the Service paid to the OEM. The costs outside of the contract — for example, of the Field Service Representatives (FSRs), transportation, housing, etc., that are incurred by the government are not taken into consideration. The charter is specific in scope, to investigate how PBLs affect the life cycle cost of a weapon system, not perform a global tabulation of life cycle costs. Thus, our lens was limited to the cost that the OEM accrued in providing the PBL "service bundle" to the government. Enterprise logistics costs, such as the Inventory Control Point (ICP) or depot surcharge were not considered in this analysis.

To counterbalance not calculating the added costs, we also did not take into consideration the cost avoidance associated with opportunities outside of the PBL program, such as when increases in supply availability allow the government to purchase fewer systems, fewer high priority requisitions, etc.

The analysis specifically investigates the price to sustain the supply support of the program under a PBL and the trend of this cost over time. In many cases, the length of the contract and the speed with which the work was accomplished limited our ability to more comprehensively capture costs. Thus, the repair and sustainment cost — regardless of these other costs — is what is under review; therefore, analyzing the variable cost for the service bundle over time will still illuminate if the life cycle cost of a weapon system changes over time as a result of a PBL initiative.

For the "usage" data, most of the systems analyzed were aircraft, so typically flight hours was the independent variable utilized. The team limited the analysis to flight hour instead of OPTEMPO because OPTEMPO takes into consideration age of aircraft, length of flight, and so forth. With this being said, it would be beyond the scope of the project, and the data required would not be available in all programs. Also, in general, the contract performance agreement was based on flight hour, not on OPTEMPO.

5.3.3 Performance Analysis

The performance metrics analysis is based on the performance metric indicated by the specific contract and confirmed by the program office as the one of most concern. Issues arose during the assessment phase for the performance metrics because many times, the Key Performance Indicators (KPIs) changed contract to contract or they were not always tracked. Similar to the cost analysis, a more detailed explanation of the analysis is provided in each program's respective section.

Limitations exist in the middle dive analysis, particularly as each PBL contract's structure differs, causing the cost and performance conclusions to be unique for each program. To completely understand the impact in life cycle cost and improved or constant performance trends, each PBL needs to be considered individually, but synthesized and examined as a portfolio.

5.3.4 Synthesis of Analysis

The middle dive looks at each program separately determining if price changed over the life of the contract, and if performance increased based on the slope of the linear regression applied. The middle dive methodology could not take a more rigorous empirical approach to determine the expected value of the change in cost over time because of the unique nature of each program.

Examination of common threads across multiple programs investigated in this initiative did allow us to infer certain PBL tenets that are more beneficial than others. The team defined five key drivers of a PBL-based data, analysis and discussions with Providers, Program Managers, SMEs, and additional outside articles:

- Contract type incentivizes cost reduction behavior and shifts the risk from the government to the provider
- Incentives and/or penalties for maintaining Key Performance Metric target(s)
- Key Performance Metric(s) manageable and measurable
- Agreed upon Key Performance Metric target level(s)
- Contract length incentivizes investments

The team graded the maturity of the PBL against the above key tenets on a scale of red, yellow, and green. The assessment was composed of a multistep approach:

4. For each tenet (listed above), the team allocated a score based on the PBL maturity captured in the figure below titled "Point Allocation".

Figure 12: Point Allocation

PBL Maturity	Harvey Ball	Score
Non-PBL: Traditional Approach		0
Better: Elements of PBL		1
Best Practice: Robust PBL		2

- We summed the score for the contract structure and execution and then divided by the total number of PBL tenets in each section resulting in a value between zero and two.
- The final step was to map the total score to the chart titled "Overall Maturity" below to determine the overall PBL maturity score for contract structure and execution.

Figure 13: Overall Maturity

Though this methodology does not statistically prove which PBL tenets, contract types, program types, and KPIs result in a more cost-effective approach, it does provide significant insights and allows for the identification of tendencies, often of more interest in the complexity in the real world. Breaking down and comparing specific PBL characteristics into smaller subsets in the search for provable causality would only serve to make a small sample size even smaller, further limiting the ability to provide a valid set of insights.

Although it does not rise to the standard of proof, the Middle Dive analysis does provide value. Consider the issue of proof in the court system. In a civil case, a finding is based on the preponderance of the evidence, which is the standard set for the Middle Dive analysis. It is only in a criminal prosecution that the decision standard rises to "beyond a shadow of a doubt."

So, though the middle dive does not rise to the standard of "beyond a shadow of a doubt," the analysis and synthesis of findings is valid and relevant. Moreover, the depth of the insights is sufficient to suggest correlation and causality.

The Middle Dive begins the exploration of whether PBL strategy drove the reduction in cost or if another outside factor affecting the change in cost, but the statistical case studies, followed by The Deep Dive analysis, add layers of evidence and suggest certain findings "beyond the shadow of a doubt."

5.3.5 Data Collection

As previously mentioned, every PBL is unique, structured in different ways, tailored to address the specific context of the program. Before diving into the numbers, the team's initial step of the middle dive process was to understand the mechanisms driving each of the PBL contracts. Multiple documents were requested from every program office for the initial research, listed in the figure below.

Figure 14: Required Documents for Analysis

Documents	
Contracts	• The initial PBL contract, and documents covering extension(s) and option period(s)
BCAs	• Every economic analysis completed to compare sustainment costs under a Non-PBL versus under a PBL arrangement
Command Briefs	• Any presentations discussing PBL strategy, contracts, negotiations/re-negotiations, costs and performance data for program X under a PBL
Award Nomination Package	• All packages submitted for the PBL award
Justification and Approval	• The document awarding the PBL contract
Additional Documentation	• Any other documents highlighting the benefits gained from executing the PBL strategy or issues that have arisen under the PBL contracts

Phone interviews and a collection of documents provided the insight required to begin the cost and performance assessment.

The second step to the middle dive analysis was to collect the cost and performance data. Even though every contract is different, there were similarities in the data requests. Figure 15 lists the data requested for the analysis.

Figure 15: Data Required for Analysis

Data for Pre-PBL and PBL (as far back as possible)

System Usage Data

- Number of Systems supported by month or quarter
- Average hours utilized by month or quarter

Costs Data

- Price to the Service for support of program X by month or quarter
- Fees broken down by month or quarter (such as Firm-Fixed-Price versus Incentive Fees)

Performance Data

- KPIs actual performance by month or quarter
- KPIs standard by month or quarter
- Other performance metrics used to assess performance by month or quarter

Example of Previous Submission

System Usage Data

Date	Number of Systems	Number of Total Flying Hours
Jan 00		
Feb 00		
Mar 00		
Apr 00		
....		
Dec 10		

Costs Data

Date	Firm-Fixed Price	Incentive Fees	Total Price to the Military Service
Jan 00			
Feb 00			
Mar 00			
Apr 00			
....			
Dec 10			

Performance data

Date	Supply Availability	Supply Availability Required	MTBF (hours)
Jan 00			
Feb 00			
Mar 00			
Apr 00			
....			
Dec 10			

5.4 Statistical Deep Dives: Empirical Exploration of Programs

This initiative seeks to examine the impact of PBL programs on cost and performance. In terms of scientific approach, the process demands empirical explorations — what are termed statistical deep dives — to the highest level of rigor and sophistication possible given the available data.

Consistent and comparable data was collected and distilled for programs during the Middle Dive Process. Based on the perceived availability of data, likely candidates for Statistical Deep Dives emerged. In total, six programs "self-selected" based on the OEM willingness to participate and the actual availability of data. Follow-up conversations and site visits ensued, in order to gain better qualitative insight and work directly with the programs to pull appropriate data.

A comprehensive Financial Analysis is possible for each of the six, and is included in the narrative review. Five of the six statistical deep dives lent themselves to an empirical case study approach.[16] In the case of the sixth, the robust data available allowed for the construction of a highly robust model supported by a statistically significant confidence level.

5.4.1 Financial Analysis

The Financial Deep Dives give a unique insight into the provider's decision making process, specifically the incentives driving strategic decisions to increase performance and drive down life cycle costs under a

[16] Theory Building from Cases: Opportunities and Challenges, Kathleen M. Eisenhardt and Melissa E. Graebner, Academy of Management Journal, 2007, Vol. 50, No. 1, 25–32.

PBL. The analysis focuses on each program's PBL contract cost structures and their impact on performance and life cycle costs. The three questions this analysis answers are:

- How does the PBL cost structure affect the life cycle cost and performance of a system, subsystem, or component?
- Are provider's decisions to drive out cost incentivized by the PBL cost structure?
- Are these saving driven by the PBL strategy realized by the government?

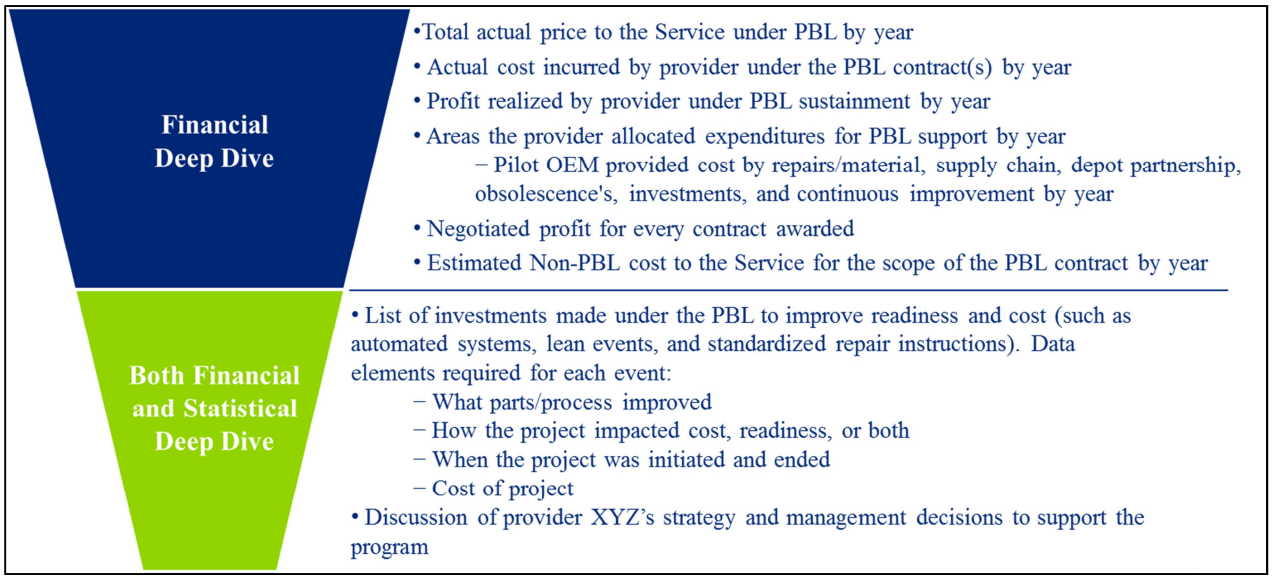
The analysis relied on financial accounting to derive the cost savings, and then links the provider's strategic decisions back to the cost savings and performance improvements.

The financial deep dive compared PBL's to an estimated non-PBL's price to the Service and cost to the provider for the same scope of work for each program's contract(s). The analysis compared the year-to-year and contract-to-contract cost structure under the PBL. These comparisons illustrated how the PBL's contract structure incentivized the providers to drive down costs to drive up profits and how the savings are then shared with the government. Also, in the renegotiation process, the savings from the previous contract should be reflected in the follow-on contract, which indicates how the PBL strategy facilitates jointly reducing costs.

A PBL shifts the underlying business model from return on sales to return on investment. This means the PBL allows the provider to have a more flexible profit margin, so driving their cost down while still remaining accountable for the performance requirement will increase their profit. To gain insight into their strategic decisions to reduce costs, the team segmented the provider's costs out in areas, such as repairs, continuous improvements, and supply chain management. By focusing on the investments and continuous improvement expenses, the team was able to identify specific investments made that directly affect cost and performance.

The figure below illustrates what is required for the financial deep dive, and also indicates the overlap of information required for both the financial and statistical deep dive and empirical case studies.

Figure 16: Data Required for Financial Deep Dive



The analysis detailed in the financial review relied on an arithmetic derivation of savings approach. While this is a compelling technique, it does not provide evidence and it does not provide a complete case. There are any number of variables that could influence system performance, and arithmetic approaches assume

that transition to an outcome-based approach is the root cause of improvement, without addressing external factors or other potential drivers. In effect, this approach assumes that the hypothesized outcome provides evidence of causality, but the linkage is deduced, not demonstrated.

5.4.2 Statistical Deep Dive Methodology

A "Statistical Deep Dive" investigation was conducted on six weapon systems, subsystems, and components, also representing all military Services and varied contract structures, to provide compelling evidence — supported by empirical rigor — of the impact of PBLs on the cost to sustain specific equipment. Both an inductive case study approach and a rigorous statistical deductive approach were used.

Across five of the programs, drawing on rigorous statistical analysis techniques, a case study research strategy to identify and investigate PBL constructs from case-based, empirical evidence drove findings with a high level of validity. The individual cases, developed with classic analytic (deductive) rigor established the basis from which to develop broader findings across the programs inductively. The findings emerge by recognizing patterns of relationships within and across cases.

In a sixth case, materiel demand/availability and cost prediction models using a mixed modeling approach relied on a quantitative analysis, using a generalized linear modeling approaches and qualitative analysis to investigate suggested links between Performance Based Logistics (PBL) strategy and changes in cost. This unique analysis was made possible due to the extraordinary completeness and depth of the data available. Statistically significant, conservative estimates for the effect of PBLs on cost and associated confidence intervals are computed and provided. While the investigation of a single program cannot be generalized to prove that PBL is effective across all programs, investigation of causality in numerous programs begins to build the tiers of evidence required to demonstrate how PBLs affect costs and performance. To support this section's conclusions, Section 5.4.2.1 analysis tests the impact of outcome-based strategies using rigorous statistical analysis.

The case study approach is an inductive approach. The robust and comprehensive analysis is an inductive approach. Inductive and deductive logics are mirrors of one another, with inductive theory building from cases to produce new theory using empirical data. Deductive theory tests inductively created theory using statistical approach and sampling. Together these two approaches complete a cycle that uses empirical data to create theory, and then uses quantitative data to test theory. By deploying both approaches, the investigation establishes a robust, comprehensive, interdependent, and mutually supporting set of statistical deep dives. Inductive case study provides a model of the whole based upon the understanding of the parts. That model of the whole is then used to provide insight into a more generalizable substantive area that can then be validated using deductive statistical techniques.

Statistical Deep Dive: Case Studies

In this study, the research relied on the data available rather than the data desired. In rare cases comprehensive data was found, allowing the application of a conventional protocol.

Commonly, in applied research, when it is impossible to address a research question with a comprehensive statistical examination of a theoretical construct, it is appropriate to apply case study methodologies. Validation from case studies provides an approach to link rich qualitative evidence to defensible conclusions. Its emphasis on developing constructs, measures, and testable theoretical propositions makes inductive case research consistent with the emphasis on testable theory within mainstream deductive research.

Central to building theory from case studies is replication logic. That is, each case serves as a distinct experiment that stands on its own as an analytic unit.

> . . . while laboratory experiments isolate the phenomena from their context, case studies emphasize the rich, real-world context in which the phenomena occur. The theory-building process occurs via recursive cycling among the case data, emerging theory, and later, extant literature. Although sometimes seen as "subjective," well-done theory building from cases is surprisingly "objective," because its close adherence to the data keeps researchers "honest." The data provide the discipline that mathematics does in formal analytic modeling.[17]

Typically, a PBL contract strategy spans three main themes. The first is to reduce demand for parts by improving system reliability. The second is to reduce the cost associated with filling demand by improving procurement and logistics. The third is to reduce cost and increase system availability by improving repair processes. These three themes, when examined across the five case studies, provide the opportunity for the "recursive cycle" and to seek common threads from disparate data across multiple programs.

Statistical Deep Dive: Robust and Comprehensive Analysis

In one case, the research uncovered a program, ALQ-126B, with deep and broad data. The data provided allowed for analysis and sophistication far beyond the typical situation. This allowed the statistical deep dive to further increase the sophistication of the analysis. While nothing can ever be asserted with absolute certainty, the evidence documented through the rigorous and comprehensive analysis rises to the level of "beyond the shadow of a doubt."

This section provides an overview of the statistical deep dive analysis on the initial PBL contract (2005-2010) for ALQ-126B. Using robust statistical techniques, the study demonstrated that the Performance Based Logistics contract drove behaviors by the OEM that reduced cost and increased performance. Moreover, two separate methodologies — the inductive financial approach and the deductive empirical approach — arrived at a numerical result that was within 2.4% of each other. This convergence provides compelling support to the conclusion that a properly executed PBL strategy reduces the life cycle cost of a system.

This section only provides an overview of the Statistical Deep Dive. A more in-depth explanation of the analysis is in Appendix A.

The goal of the analysis was to statistically test the relationship among PBL strategy, cost reductions, and performance increases.

More specifically, we test that the demand for parts, generally, went down over a PBL contract period and management efficiently targeted those parts with high cost or demand to drive out costs.

The data required built upon the solicited data for the financial deep dive, but dove deeper into the data and analysis, illustrated in the figure below [PROPRIETARY INFORMATION – REDACTED].

A data set of demands per month and an average cost for each part under a PBL contract was utilized to predict the change in demand to then estimate the change in cost. This reduction was then linked back to management investments and initiatives (e.g., six sigma, DMS redesign, Web-based repair instructions) that led to the demand reduction. Therefore, the linkage of PBL strategy to a reduction in life cycle cost is tested by keeping cost per part constant and directly correlating the reduction in provider's total cost to the provider's investment decisions to increase reliability to drive down demands.

[17] Theory Building from Cases: Opportunities and Challenges, Kathleen M. Eisenhardt and Melissa E. Graebner, Academy of Management Journal, 2007, Vol. 50, No. 1, 25–32.

As with all research, there are limitations with this study. The current study:

- Lacked pre-PBL demand data to baseline the analysis
- Assumed that as the system aged the demand would remain flat, which is a conservative estimate for demand
- Assumed consistent system usage throughout the life of the PBL based upon input from the OEM, because supporting data was not tracked

Research methodologies and analyses were developed to mitigate the impact of limitations on the conclusion.

6.0 Quantitative Findings

Based on the analysis, we concluded that PBL arrangements can reduce DoD costs per unit of performance while simultaneously driving up the absolute levels of system, subsystem, and component readiness/availability. Even though few of the PBL arrangements adhered to the "ideal" tenets of PBL contracts or oversight, these positive impact findings still held true as performance increased on 17 of 18 PBL arrangements with performance incentives, and 12 out of 14 PBLs with cost reduction incentives embedded in the contractual arrangement, delivered price-to Service reduction over the life of the PBL.

6.1 Middle Dives

As previously discussed, the middle dive analysis contains four elements: Program Basics, Cost per Unit of Performance (Cost/Price Calculation), Performance, and PBL Maturity. This section examines the middle dive analysis for each of the 21 programs.

An aggregated table of our analysis is provided in the following figures [PROPRIETARY INFORMATION – REDACTED]. The programs are listed based on an assessment of the programs' PBL Maturity.

Examination of common threads across multiple programs investigated in this initiative did allow us to infer certain PBL tenets that are more beneficial than others. The team defined five key drivers of a PBL, based on data analysis, discussions with Providers, Program Managers, SMEs, and additional outside articles:

- Contract type incentivizes cost reduction behavior and shifts the risk from the government to the provider
- Incentives and/or penalties for maintaining Key Performance Indicator target(s)
- Key Performance Indicator(s) manageable and measurable
- Agreed upon Key Performance Indicator target level(s)
- Contract length incentivizes investments

The team graded the maturity of the PBL against the above key tenets on a scale of red, yellow, and green. Though this methodology does not statistically prove which PBL tenets, contract types, program types, and KPIs result in a more cost-effective approach, it does provide significant insights and allows for the identification of tendencies, often of more interest in the complexity in the real world. Breaking down and comparing specific PBL characteristics into smaller subsets in the search for provable causality would only serve to make a small sample size even smaller, further limiting the ability to provide a valid set of insights.

In the next set of figures [PROPRIETARY INFORMATION – REDACTED], the squares indicate programs where the data could not be validated, and the asterisks indicate programs where performance met or exceeded the contract performance targets, but did not have a pre-PBL contract to compare the performance against. Seventeen out of twenty one programs had decreasing costs over the life of the PBL, and twenty out of twenty one programs had increasing performance. It is critical to note that 12 of 14 PBLs, with cost reduction incentives embedded in the contractual arrangement, delivered price-to-Service reductions over the life of the PBL, and 17 of 18 PBLs, with targeted performance objectives/performance improvement incentives embedded in the contractual arrangement, delivered improved performance over the life of the PBL. The rows which are shaded green indicate the Empirical Case Studies and deep dive programs.

Four of twenty one programs had increasing costs over time, however, all four of these programs had one-year contracts and limited adherence to the PBL tenets. The only program where performance did not exceed the requirement was F/A-18 FIRST, and the deep dive analysis indicated that poor execution caused this result. The seven programs that did not have pre-PBL data are identified with an asterisk limiting the team's ability to say with certainty the PBL strategy improved performance compared to a non-PBL arrangement. Despite this limitation, the seven PBL programs are currently exceeding the expectations of the PBL contract substantially with performance levels suggesting to be significantly better than under non-PBL arrangements. The information requested from the F404 engine program was not provided. Two of the program's costs were indeterminable, H-60 Tip-to-Tail and Army Common Ground Station. The H-60 program had scope changes three different times over the course of the PBL, therefore, no two years were comparable. The Army Common Ground Station did not have sufficient financial data to conduct an analysis of the programs' impact on cost.

The evidence generated by the 21 programs analyzed clearly demonstrated overall decreased costs and improved performance. The preponderance of the evidence leads to the conclusion that contract length and contract type affect the price to the Service.

7.0 Qualitative Findings

This study focused on analyses of the information and data necessary to provide conclusive evidence regarding the impact of PBLs on the costs for sustaining DoD systems, subsystems and components. In the process of gathering the information and data essential to perform the analyses, the team gained significant insight into many qualitative factors effecting sustainment practices in the Department and industry. Should the Department decide to aggressively pursue broad-based deployment of PBL arrangements, a clear understanding of these qualitative issues will be essential to success. Included among the more significant observations not associated with the data analyses are:

1. While there is a very small cadre of proponents in Program Offices who are actively pursuing PBLs, the apparent enterprise "appetite" for making the transition from transactional sustainment is not significant enough to reverse the downward trajectory. Today there are only half the PBL arrangements in place as there were in 2005 and the Services are making plans to not renew some of the existing PBLs when their current contracts expire. The team's assessment of some of the factors driving this lack of appetite are:

    a) Service equities – legacy sustainment culture. Quite simply, PBLs present the Services with a transformational change challenge that is both complex and most often involves the transfer of workload (accompanied by a sense of loss of control) to the commercial sector. The military Services do not have a strong history of imposing these types of changes upon themselves.

    b) Full costing organic DoD sustainment. The full price of commercially provided PBL sustainment is clearly known by the Services – it is the amount paid to the provider. In contrast, fully costing organic DoD sustainment is difficult if not impossible given existing funds flows and accounting capabilities.

    c) Absence of robust BCAs, agreed upon facts and transparency of data. Bottom line: in many if not most situations, decision makers do not have the quantity and quality of information and data essential to execute their roles with confidence. This lack of hard data has also led to strong assertions by both PBL proponents and critics in the absence of compelling evidence to support their positions.

    d) Speed-to-savings, what's in it for the Service <u>now?</u> Unlike transactional sustainment where saving can be harvested through the simple act of a budget cut, PBL savings are a lead time away from the initial planning process.

2. No effective "forcing function" exists at the OSD or military Service HQ level to drive PBL adoption. This includes the absence of a shared vision, a strategy and a Roadmap to achieve the strategy, effective governance, an understanding of the universe of systems, subsystems and components that are PBL candidates, agreed upon metrics to measure progress, targets against the agreed upon metrics, a capability to track and report programmatic information and data and accountability for outcomes… to list a few. That the DoD Directive 5000.02 mandates PBL as the Department's sustainment strategy and that PBL have not been broadly deployed across the department clearly illustrates that directives are not forcing functions.

3. The initial complexity of PBLs versus transactional sustainment. The potential savings associated with deploying PBLs comes with the requirement for Program Office and acquisition skills essential to plan, execute, manage and re-negotiate complex sustainment arrangements involving both organic and industrial base expertise. Transactional Program and acquisition skills are not transferable to PBLs. The study team observed a number of situations where the DoD offices responsible for establishing and managing the PBL arrangement appeared to be

treating their sustainment contract as transactional or a "fire and forget" arrangement. Again, while there is a very small cadre of truly excellent DoD PBL practitioners, in general the Services do not appear to have the broad-based expertise essential to drive PBLs across the Department.

4. Flexibility of PBLs versus transactional sustainment. The Services correctly note that PBL arrangements typically offer less financial flexibility in the year of execution and are more difficult to establish and manage in light of the inherent uncertainty of military operations. The Services also correctly note that the so-called 50–50 legislation adds an additional degree of difficulty, if the PBL arrangement is being undertaken with a commercial provider. These concerns can be successfully addressed with a nuanced application of the contractual options afforded by the PBL strategy and implementation of Public Private Partnerships.

PBLs may create "stranded costs". The Services also correctly note that transfer of a sustainment function from one DoD activity to another or from the DoD to a commercial entity is not always accompanied by the elimination of all costs associated with the function at the transferring DoD activity. If not addressed through re-structuring at the transferring activity the "stranded costs" act as off-sets to savings generated by the creation of the PBL arrangement. Refinement of DoD infrastructure costs in the face of declining budgets, Program phase-outs, BRAC consolidations, and organizational mergers… as well as PBLs… is essential.

8.0 Recommendations to Improve Execution of PBL Strategy

The potential for recurring savings and performance improvements that would accompany the widespread deployment of PBL sustainment arrangements is immense. However, during the course of the analysis, the study team encountered a number of obstacles to the realization of these improvements. To provide a future that includes dramatically expanded PBL deployment and associated savings, a significant shift in Departmental PBL dynamics will be required. Specific study team recommendations include:

5. Socialize this study's findings broadly to end the debate regarding the relative merits of PBLs
6. OSD, military Service and Defense Logistics Agency leadership should align — and remain aligned — around a shared sustainment vision
7. Craft a robust strategy to support the vision, and an executable Blueprint or Roadmap (with specific, measurable, actionable, relevant and time phased actions with personal accountability established) to deliver the strategy
8. Appropriately resource the Strategy and Blueprint/Roadmap throughout – including funding and expertise: commercial and DoD PBL expertise (specifically, PBL acquisition strategy), supply chain, human capital, training, coaching, financial and risk mitigation
9. Institutionalize an effective and efficient top-to-bottom PBL enterprise governance construct
10. Manage the strategy throughout execution
11. Augment the organic workforce - for the near-term
12. Re-tool the organic workforce with the nuanced PM and acquisition skills required for success
13. Build and maintain a broad-based "Community of Practice"
14. Develop a portfolio of agreed-upon Key Performance Indicators (KPI)
15. Identify and catalog the complete universe of current and potential PBL systems, subsystems, and major components –
16. Develop a prioritized plan to migrate non-PBL systems, subsystems and components to PBL, when appropriate

17. Develop goals and/or target performance levels for the agreed-upon portfolio of KPIs
18. Develop a PBL performance tracking capability
19. Track, review and manage KPI goal achievement along with all other relevant management data at all management levels (where required, secure environments will be established for the exchange of classified or competition-sensitive information)
20. Continually develop and sustain a broad-based cadre of highly skilled PBL practitioners in numbers sufficient to support the full spectrum of current and potential equipments
21. Develop standard and repeatable DoD PBL implementation and execution processes. Gaining Service acceptance of the PBL business model for weapon system sustainment will require a robust implementation process that includes a standard and repeatable process for PBL execution. Implementation should largely be the purview of the Services with some early implementation assistance
22. Revise Departmental, military Service, and Defense Logistics Agency policy in line with the above and enforce
23. Achieve and maintain accountability and compliance with policy and guidance

9.0 Summary

Conventional wisdom suggests that improved sustainment performance can only be realized through higher maintenance and repair costs. As documented in this report, PBLs have the proven ability to deliver superior performance at reduced cost when compared to non-PBL arrangements. Both business theory and the actual results achieved in practice illustrate why this is true.

Traditional transactional-based sustainment approaches fail to align the interests and incentives of those entities responsible for establishing and managing equipment sustainment strategies and those entities responsible for performing maintenance/repairs. In many instances, the incentives of the two sides are diametrically opposed. When sustainment providers are paid per maintenance action, their financial situations are enhanced by the need for additional maintenance. Furthermore, where the profit margin per maintenance action is a fixed percent of the total cost to repair, the provider's financial situation is improved by holding the cost to repair at the highest possible level. Finally, in situations where sustainment providers are either monopolies or oligopolies, which is very often the case in the defense space, there are perverse, very few, or no incentives to improve product reliability, maintainability, or hold-down costs — again, because the provider's financial situation is improved as the need for maintenance, parts, and the overall price-to-maintain increase.

In transactional sustainment arrangements, the incentives are neutral at best and more likely tilted against the military Services and Defense Logistics Agency. Compounding this problem is that essentially all financial and performance risks reside with the Services.

By contrast, PBLs are far more effective, but not perfect, in aligning the interests and incentives of those entities responsible for establishing and managing equipment sustainment strategies and those entities responsible for performing maintenance/repairs. When sustainment providers are paid a firm-fixed price for established levels of performance, they improve their financial situation by driving down additional maintenance. When this is coupled with an assured, long term income stream, which is often preferred over higher profit margins with less certainty, providers are further incentivized to invest in process and reliability improvements. The study team uncovered numerous examples of companies making investments in reliability improvements to drive down equipment MTBF that resulted in dramatically improved materiel performance.

Where the PBL provider's profit margin per maintenance action is not a fixed percentage of the total cost to repair, the provider's financial situation is improved by driving down the cost to repair. Here too, the study team uncovered numerous examples of companies making significant investments to lean processes that resulted in dramatically reduced MTTR and reduced demand for additional equipment populations necessary to support lengthy maintenance pipelines.

PBLs incentivize out-of-pocket reliability and process improvement investments in Firm-Fixed-Price contract situations, which indicates the need for a paradigm shift, whereby competition is understood to include situations where companies compete aggressively against their own internal quality and inefficiency challenges in order to increase profits. A concomitant benefit of industry's investment in innovation is that it enhances U.S. manufacturers' state-of-the-art capability and the nation's overall national security and economic posture.

Traditional, transactional sustainment contracts do not incentivize this behavior in either monopolistic or oligopolistic markets and do so only to a very small degree in more competitive spaces.

It must be strongly emphasized that PBLs do not perfectly align the interests of the entities responsible for establishing equipment sustainment strategies and those entities responsible for performing maintenance. PBL providers are very often monopolies or oligopolies with legally binding mandates to maximize shareholder value and maximize long-term profits. As a result, PBL contracts must be skillfully constructed, managed, and renegotiated/ re-competed.

More specifically, it is essential that commercial providers retain the opportunity to realize profitability commensurate with the risks embedded in Firm-Fixed-Price contracts and their out-of-pocket investments to improve reliability, maintainability, and price to repair. It is equally essential that the government orchestrate the PBL arrangement throughout the equipment's life cycle to confirm an equitable distribution of risks and rewards among the parties to the PBL contract.

In PBL sustainment arrangements, the military Services and Defense Logistics Agency find themselves on a far more level and financially advantageous playing field with their PBL providers. Further enhancing this situation is the reduction of overall program risk and the transfer of these risks from those entities responsible for establishing and managing equipment sustainment strategies to those entities responsible for performing maintenance.

The potential savings and performance improvements inherent in the widespread application of PBL sustainment arrangements are immense. PBL's distinct advantage over transactional sustainment arrangements are not in doubt. It is time to press forward and broadly deploy PBLs to the military Service's weapon systems, subsystems, and major components — employing either organic or commercial sustainment providers.