# DoD Weapon System Acquisition Reform
## Product Support Assessment

November 2009

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# Foreword

As DoD moves forward with weapon system acquisition reform, attention to product support must be increased, and life cycle management must be better focused to achieve affordable operational Warfighter outcomes. Too often in the past, weapon system product support has been neglected in acquisition and logistics transformation efforts. Therefore, if the Department is going to truly reform the business of delivering weapon system capabilities to the Warfighter, it must also reform the stewardship of the $132 billion spent each year in product support. Reformed stewardship—driven by improving product support and achieving more cost-effective weapon system readiness outcomes—requires a life cycle management focus, committed leadership, and cooperative efforts from the operational, acquisition, and logistics communities.

This **DoD *Weapon System Acquisition* Reform *Product Support Assessment*** captures the findings and recommendations needed to drive the next generation of product support strategies. During its year-long study, our 65-member pan-DoD and industry team, led by the Office of the Deputy Under Secretary of Defense for Logistics and Materiel Readiness, identified eight principal areas that, if developed or improved, will make product support more effective and acquisition reform more far-reaching:

1. Product Support Business Model
2. Industrial Integration Strategy
3. Supply Chain Operational Strategy
4. Governance
5. Metrics
6. Operating and Support Costs
7. Analytical Tools
8. Human Capital

I appreciate the team's work to arrive at these findings and to publish this comprehensive report. Please be assured you will have my support during implementation of the eight recommendations. I look forward to working with the DoD Components and Agencies, Congress, Industry, and the Warfighter as we implement successful change in weapon system product support and acquisition reform. Your cooperation is paramount. Let's drive this effort home!

Ashton B. Carter
Under Secretary of Defense
for Acquisition, Technology and Logistics

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# Executive Summary

## Introduction

Weapon system product support operates at the intersection of Defense acquisition and logistics.[1] *Product support*, also referred to as *system sustainment*, is the package of support functions required to maintain the readiness and operational capability of weapon systems, subsystems, software, and support systems. It encompasses materiel management, distribution, technical data management, maintenance, training, cataloging, configuration management, engineering support, repair parts management, failure reporting and analysis, and reliability growth. Product support considerations, germane to both acquisition and logistics, are necessary throughout the DoD life cycle framework, beginning with early requirements determination and continuing through system design, development, operational use, retirement, and disposal.

Spurred by perceived and documented shortcomings in the cost-effective procurement and affordable operation of DoD systems, acquisition and logistics processes have been the recurring focus of Defense studies, reform efforts, and transformation initiatives. Despite more than 130 studies and commissions on Defense acquisition since World War II, acquisition core problems persist, according to the Secretary and Deputy Secretary of Defense. And, despite more than 90 logistics reform, reengineering, modernization, and similar strategic studies and plans in the past 20 years, no broad consensus has emerged on DoD logistics transformation. Both areas have been on the Government Accountability Office (GAO) High-Risk List for the past 19 years—the only Defense business areas with this unenviable track record. Acquisition processes pay too little attention to supportability and consistently trade down-stream sustainability for required capability or program survival. Some Program Managers assert that "logistics is their only discretionary account," making it a frequent target for inevitable resource reductions. In acquisition decision reviews, sustainment is often relegated to the back-up charts. Hampered by functionally stove-piped organizational structures and lacking life cycle management qualifications in their diverse workforce, the logistics community fails to achieve effectively integrated and affordable Warfighter operational readiness. Instead, it remains focused on managing commodities, parts, and services.

> Product support, vital to both acquisition and logistics, has been treated as the stepchild of both functions. The acquisition community has neglected it, and the logistics community seems mismatched to effectively perform its demanding scope.

It is crucial to our national interest that product support achieves a level of performance equal to its critical importance. This report, inspired by a Warfighter-driven operational perspective, offers clearly defined, implementable recommendations to drive the next generation of product support strategies toward that objective, with a clear vision to achieve ***aligned and synchronized operational, acquisition, and sustainment communities working together to deliver required and affordable Warfighter outcomes.***

[1] The term "weapon system product support" will be used routinely in this report. The authors acknowledge that all DoD systems are not weapon systems. Many are business, information technology, command and control, and other types of materiel systems. The scope of this report is applicable to the product support of all such systems.

## Background

Defense product support is big business, costing at least $132 billion in FY 2008.[2] This scope is not surprising given that in FY 2008, DoD logistics accounted for about $190 billion[3] of Operations and Maintenance and Personnel appropriations and that DoD acquisition spending was about $165 billion.[4] The clamor for more effective and affordable product support faces many challenges. The exigencies of irregular warfare, harsh theaters of operation, and intense operational tempos put severe upward pressure on support costs. But despite these challenges, progress has been made and the opportunity for more progress is available. There has been an increasing focus on product support over the last ten years, as exhibited in DoD policy and guidance. Responding to Congressional direction to reengineer product support, DoD completed a comprehensive review summarized in the 1999 report *Product Support for the 21st Century* that became the impetus for many of the strategies applied over the last decade. As a result of that effort, the DoD strategy for product support is evolving from traditional "transactional" logistics concepts, in which the components of readiness are acquired as discrete unit transactions, to a stronger emphasis on acquiring the operational readiness outcomes themselves. The poster child of this latter approach (and by policy, DoD's preferred sustainment concept) is called Performance Based Logistics, more commonly referred to by its acronym PBL.

PBL was and is transformative. Jacques Gansler, Under Secretary of Defense for Acquisition, Technology, and Logistics, from 1997 to 2001 described the context of what needed transforming at that time:

> *…to reverse this trend—with current short-term needs consuming an ever-increasing 'share of the pie' at the expense of longer-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.*

Developed in response to the death spiral of decreasing readiness and increasing costs in the 1990s, PBL strategies were an attempt to reverse this trend. Today, there are approximately 200 PBL applications in DoD. The number appears inflated because many platform systems have multiple PBL subsystem applications, so currently, only about 20 percent of DoD weapon systems utilize a PBL strategy in whole or part. Despite a relatively slow adoption rate, the strategy shows signs of institutionalization in the military Services.

PBL has its critics, consequences, and challenges. For example, few argue with PBL's performance improvements, but many question its cost effectiveness. Although fully intended as a product support strategy embracing the best of the public and private sector to produce system readiness outcomes, PBL has been viewed by many as primarily a "contracting for logistics" strategy. All PBL approaches, like all traditional strategies, rely on a combination of organic and contractor support. Unlike traditional strategies, PBL has significantly leveraged and incentivized use of private sector competencies, capabilities, and processes to create the perception of outsourcing logistics. Other cited shortcomings are a failure to spawn the desired

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[2] Not counting the procurement and R&D costs associated with product support.

[3] See Appendix D for details.

[4] FY 2010 DoD Financial Summary Tables, page 1. http://www.defenselink.mil/comptroller/Budget2010.html, accessed 03 September 2009.

product support competitive base, a failure to establish long-term contractual off-ramps, and difficulty in displaying auditable financial benefits. Given these consequences and challenges, critics are quick to urge abandonment or change. Still, there remains a strong consensus that an outcome-based, performance-oriented product support strategy is a worthy objective, but currently, these labels are inextricably linked to PBL. In that context, "what to do about PBL," or "where to go after PBL," is the major product support strategy debate. That issue, and that view, is too narrow. There are broader issues confronting product support for the next generation.

The issues that hamper our institutional sustainment processes are systemic. While military operations have become increasingly joint, sustainment processes remain overwhelmingly Service-centric. Product support, despite significant policy and guidance on increased governance and the need to transition to performance-based strategies, reflects only marginal progress on both fronts. Determination of best value support strategies is based on a Business Case Analysis (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. The logistics information technology infrastructure has been slow to modernize and is challenged to optimize the integration of vertical weapon system supply chains with traditional horizontal commodity-based supply chain processes. Acquisition and logistics workforce assessments have reported weaknesses in both communities, citing shortcomings in competencies and culture needed to translate Warfighter performance requirements into cost-effective product support spanning the weapon system life cycle.

> While military operations have become increasingly joint, sustainment processes remain overwhelmingly Service-centric.

Despite these 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. In that context, the Office of the Secretary of Defense (OSD) Logistics & Materiel Readiness (L&MR) realized this opportunity and established a group of senior government and industry personnel—the Product Support Assessment Team (PSAT)—to assess and offer opportunities for improving product life cycle support.[5] The PSAT established ambitious objectives for the review effort:

- Identify the current status of product support and implementation across the DoD enterprise,
- Identify areas for improvement to procedures and associated policies, and
- Publish a state of product support assessment with recommendations describing a way forward to develop and implement a next-generation life cycle product support business model and related enabling strategies.

To accomplish these objectives, the team implemented a three-phase general process methodology:

[5] U.S. Department of Defense, Deputy Under Secretary of Defense for Logistics and Materiel Readiness, *Product Support Assessment Team* Memorandum, 05 September 2008.

- **Discovery and Assessment:** The team analyzed over 20 major topics, collecting and examining weapon system data related to the product support environment. The team focused on the perspectives of strategy, policy, processes, and resources to qualitatively and quantitatively assess the major topic areas.
- **Product Build:** The team collectively synthesized the key issues, root causes, and findings, distilling over 100 recommendations down to eight principal recommendations for improving DoD product support processes.
- **Implementation Ramp-up:** The team identified implementation actions for each recommendation.

Concurrent with the three review phases, weapon system data was collected and analyzed for 34 programs. This data provided insight into a diverse range of product support strategies associated with a historical profile of operating and support costs and availability levels of respective programs. The weapon system analysis provided a quantitative baseline, which, combined with qualitative data, forms the foundation upon which the resulting recommendations have been validated in each of the major topic areas.

PSAT guidance was provided by a Senior Steering Group (SSG) that guided the overall PSAT process and reviewed the emerging findings and recommendations. Members of the SSG consisted of general/flag-level officers, senior executives, and leaders from the Department of Defense and industry associations.

## Summary of Findings

There were three major categories of analyses conducted during this study:

1. Maturity assessments of product support processes and identification of major issue areas
2. Root-cause analysis of major product support issue areas
3. Insight and supporting information from the weapon system data analysis

As highlighted in Table 1 and below, the summary of findings is as follows:

The maturity assessments reflected consistent weaknesses in virtually all key product support processes. None of the areas studied achieved a maturity rating above average. The most mature process areas were customer-facing metrics and performance outcomes, while the weakest areas were business case analysis process and cross-Service alignment.

*Table 1: Summary of Study Findings*

| | |
|---|---|
| **Maturity Assessments of Product Support Processes** | ▪ Maturity assessments reflected consistent weaknesses in virtually all key product support processes<br>▪ None of the areas studied achieved a maturity rating above average<br>▪ The most mature process areas were ***customer-facing metrics and performance outcomes***<br>▪ The weakest areas were ***business case analysis process*** and ***cross-service alignment*** |
| **Root-Cause Analysis of Major Product Support Issue Areas** | ▪ Continued reliance on transactional based systems and processes<br>▪ Inadequate human capital<br>▪ Need for smart managers and smart buyers<br>▪ Organizational challenges<br>▪ Lack of shared goals |
| **Weapon System Data Analysis** | ▪ Performance-based (outcome-based) product support strategies, particularly when coupled with government-industry partnering approaches, have consistently delivered improved materiel readiness across numerous weapon system applications over the past decade<br>▪ Cost benefits are more difficult to assess; as cited in several GAO reports, many outcome-based support strategies have claimed cost reductions and cost avoidance, but DoD financial systems lack the visibility and fidelity to validate these benefits consistent with audit standards |

The team conducted root-cause analysis on major product support issue areas and found consistent themes throughout. Specifically, product support suffers largely from continued reliance on transactional based systems and processes, inadequate human capital, need for smart managers and smart buyers, organizational challenges, and a lack of shared goals.

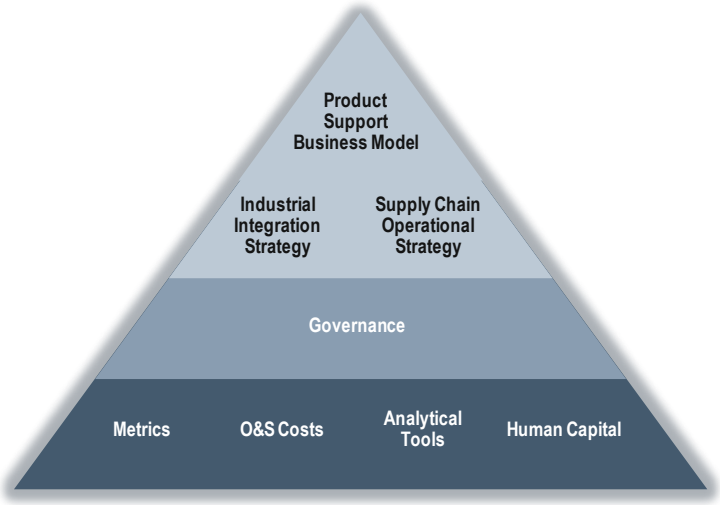
While there are a range of indicators resulting from the maturity assessments and root-cause analysis, the weapon system data analysis clearly shows that performance-based (outcome-based) product support strategies, particularly when coupled with government-industry partnering approaches, have consistently delivered improved materiel readiness across numerous weapon system applications over the past decade. Cost benefits are more difficult to assess; as cited in several GAO reports, many outcome-based support strategies have claimed cost reductions and cost avoidance, but DoD financial systems lack the visibility and fidelity to validate these benefits consistent with audit standards. In summary, performance-based product support strategies consistently deliver improved materiel readiness, but assessing the true cost of both traditional (transactional) and performance-based strategies is difficult, if not impossible, given current financial systems.

## Recommendations

Eight principal recommendations resulted from the collection and analysis of the study data. Figure 1 summarizes the eight recommendation areas, reflecting the symbiotic relationship among the recommendation categories. Within the pyramid model, the top two bands are recommendations that reflect strategic priority initiatives; the third band reflects the critical governance processes necessary to provide product support accountability across the life cycle;

and the pyramid base reflects the aspects, which enable the recommendations necessary to implement the higher-level reforms.

***Figure 1: PSAT Recommendation Areas***




**Product Support Business Model:** The PSAT recommends adoption of a new model that capitalizes on an integrated defense industrial base and performance outcomes to enable cost effective capability across the weapon system life cycle. The business model, described in the full report, provides a clearly defined framework that will facilitate the continuous identification of the appropriate product support strategy consistent with the objective of the system over its life cycle. The model is supported with a decision matrix using two fundamental axes:

1. Application Strategy: system, subsystem, or component level
2. Product Support Integration: industry, organic, or integrated partnership[6]

**Industrial Integration Strategy:** Study data clearly showed tangible benefits from government-industry partnering. In conjunction with assessing programs utilizing partnerships, the team compiled a framework outlining the characteristics of good partnerships. This recommendation emphasizes the need for continued evolution of public-private partnering strategies beyond the current depot maintenance focus into other support functions. This will facilitate more effective industrial integration that will provide broad-ranging product support capabilities, leveraging the talents, expertise, and infrastructure of both the commercial and organic industrial base.

**Supply Chain Operational Strategy:** Given the critical relationship of maintenance and supply in the DoD composite supply chain, the team recognized the critical need to connect platform product support strategies to the enterprise supply chain approaches that produce the best value across the DoD Components. DoD supply chains, focused largely on commodity management practices, must extend into both system-level and enterprise-level strategies, enabling and leveraging the consolidated benefits of a cross-enterprise, joint management approach.

[6] Unless defined as a Public-Private Partnership, "partnership" means Performance Based Partnership (PBP) where there is a defined formal performance expectation between at least two organizations, where one partner performs any relevant product support function that complements the functions performed by the other partners.

**Governance:** Despite increased rhetoric emphasizing the importance of product support, no compelling or cohesive life cycle governance framework that includes formal consideration of product support has been defined, much less implemented. There is little attention to, incenting of, or penalties for not achieving effective sustainment objectives over the life cycle. Systemic governance of product support must be institutionalized via policy, guidance, and review activities that strengthen, develop, and enforce organization and management sustainment processes.

**Metrics:** Performance-based (outcome-based) product support strategies will continue to be emphasized and implemented in both industry and organic sustainment approaches. As such, the establishment of more comprehensive guidance regarding the selection and application of metrics to assess, incent, and monitor product support over the life cycle is critical to both effective governance and management of sustainment strategies.

**Operating and Support Costs:** The lack of an affordability requirement and adequate visibility of operating and support costs has been a long-standing barrier to effectively assessing, managing, and validating the benefits or shortcomings of product support strategies. The report defines specific initiatives necessary to make the much needed, fundamental improvements in financial visibility and accountability.

**Analytical Tools:** The use of the BCA process to make life cycle product support decisions, mandated by policy since 2004, has been plagued with problems of inaccuracy, inconsistent application across the Services and weapon systems, and a general failure to achieve the purpose for which it was intended. For BCAs to improve in effectiveness as a decision-making tool, it is necessary to address, clarify, and codify the larger group of "analytical tools" by which the analysis should be conducted. The report provides a specific plan of action to achieve this objective.

**Human Capital:** Both the DoD acquisition and logistics workforces face significant challenges in attaining the professionalism and knowledge base to serve as smart buyers and managers of integrated life cycle product support. DoD must set clear objectives to integrate product support competencies across the acquisition and logistics workforce domains to institutionalize the successful traits of an outcome-based culture. Further, industry product support personnel, along with their government colleagues, must be more seamlessly equipped to acquire requisite product support competencies and proficiencies.

## Implementation Actions

Implementation of the proposed recommendations can be facilitated by empowering three integrated product teams (IPTs) to move forward with precise agendas:

- **IPT #1: Product Support Business Model.** This strategically focused team is responsible for developing and institutionalizing the product support business model. This is accomplished by pursuing initiatives to align and expand government/industry partnerships and connect weapon system product support strategies to outcome-based approaches utilizing enterprise-focused supply chain management practices.
- **IPT #2: Governance.** This team is responsible for developing and institutionalizing improved governance of product support across the life cycle,

including sustainment metrics and governance activities, such as milestones, reviews, and other product support assessment actions.

- **IPT #3: Human Capital.** This team is responsible for defining and shaping the professional workforce necessary to execute the new product support environment, which clearly requires a more skill-matched, flexible, knowledgeable, and professionally trained human capital component.

Management oversight for these three teams should be provided by reorganizing the PSAT Senior Steering Group into a standing Product Support Executive Council (PSEC). This executive group's efforts should be aligned with other related senior-level groups, such as the Maintenance Executive Steering Committee, the Joint Logistics Board, the Weapon Systems Lifecycle Management Group, and the DoD Logistics Human Capital Executive Steering Group.

## Conclusion

Transforming product support will require not only strong leadership in the Department of Defense, but also an open-minded, reform-driven DoD-Congressional partnership and a collaborative DoD-Industry relationship to realize the report objectives. The national security and economic environments dictate tough-minded acquisition reform and logistics transformation. The challenges of affordability constraints, the need to upgrade equipment and infrastructure, and a continuing, persistent operations tempo prescribe 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.

As DoD moves forward with acquisition reform and improved life cycle management practices, product support improvement is a key enabler of these critical implementation efforts. The recommendations included in this report will yield a higher level of effectiveness in overall acquisition and logistics processes, and in turn, significantly improve the sustained capability and affordability of our weapons systems.

## Organization of This Report

This report describes the PSAT's analytical methodology, recommendations, and necessary implementation actions for achieving long-term logistics and product support transformation consistent with the objectives and initiatives of Acquisition Reform, the Department's 2009 Quadrennial Defense Review (QDR) and other strategic change processes.

Chapter 1 of this report defines the product support challenge from past to present. Chapter 2 describes the PSAT methodology. Chapter 3 outlines the product support business model that provides a structure to enable and facilitate more effective performance-based relationships. Expanding on two elements of the model, Chapter 4 discusses recommendations and key tasks related to public-private partnerships and the supply chain operational strategy. Recommendations related to product support governance, metrics, O&S costs, analytical tools, and human capital are core to Chapter 5. Chapter 6 defines the management tools and actions necessary to achieve implementation of the recommendations found in Chapters 3 through 5. Finally, Chapter 7 closes the report by establishing leadership accountability and defining the critical paths for realizing PSAT success.

# Chapter 1: The Product Support Challenge

## Background

*Product support*, also referred to as *system sustainment*, is the package of support functions required to maintain the readiness and operational capability of weapon systems, subsystems, software, and support systems. It encompasses materiel management, distribution, technical data management, maintenance, training, cataloging, configuration management, engineering support, repair parts management, failure reporting and analysis, and reliability growth. The source of product support may be organic or commercial, but its primary focus is to optimize customer support and achieve maximum weapon system availability at the lowest total ownership cost. Product Support is the primary means by which Warfighter-driven materiel readiness expectations are accomplished over the weapon system life cycle.

Product support is an essential competency in DoD's portfolio of military capabilities, drawing on organic (government-owned) and commercial industry labor, facilities, and assets. Product support decisions involve integrating various capabilities and options to optimize Warfighter support and weapon system availability within affordability constraints. Ultimately, product support is anchored in the needs of the Warfighter in that it must consistently deliver those capabilities required at the "tip of the spear."

The concepts behind today's product support date back more than a decade to FY 1998 Section 912(c) of the National Defense Authorization Act and the July 1999 *Product Support for the 21st Century: Report of the Department of Defense Product Support Reengineering Implementation Team*, which responded to the Section 912(c) Congressional requirement.

The 1999 report focused on DoD's ability to realize four key "focus areas." These were:

1. Reengineering product support processes to best commercial practices
2. Competitively sourcing product support
3. Modernizing through spares
4. Expanding prime vendor and virtual prime vendor

Measures of success toward enabling and implementing these focus areas were determined by the factors in Table 2.

*Table 2: 1999 Factors for Improved Product Support*

| Success Indicators |
| --- |
| ▪ Integrated logistics chains focused on customer service |
| ▪ Customer relationships based on output |
| ▪ Logistics chains integrated across industry and government |
| ▪ Best-value providers selected from government, industry, or partnerships |
| ▪ Support environment that maintains long-term competitive pressures |
| ▪ Secure, integrated info system across industry and government, enabling supply chain integration and full asset visibility |
| ▪ Continuous improvement of weapon systems RM&S-dedicated investments |
| ▪ Effective integration of weapon system-focused support to provide total combat logistics |

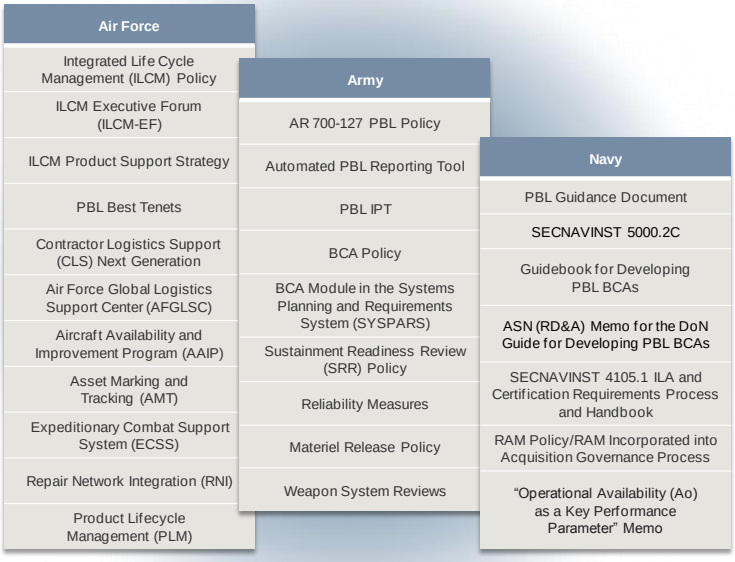
In 2000, DoD delivered a status report on product support reform. The initial progress report documented some successes, providing promise of continuing improvements in product support reform. However, the events of September 11, 2001, changed the focus of the Department almost overnight—the impetus of product support transformation was transcended by the compelling need to support the Warfighter in two remote and austere environments. Affordable supportability became less of a priority as Warfighter-readiness needs became paramount.

Yet, in spite of prolonged Warfighter involvement in contingency actions over the past decade, key product support initiatives were still implemented. Foremost among these was DoD's adoption of Performance Based Logistics (PBL), an outcome-based approach, as its preferred sustainment strategy. This approach linked sustainment objectives and resources to system performance, not repair and supply activities; goals and incentives became structured around system performance, not failure; and risk was shifted to the support provider. PBL became the Department's preferred sustainment strategy because it delivered higher equipment readiness levels, applied best commercial practices, provided inherent product support integration, and provided a common strategy to bridge the acquisition and sustainment communities. Public-Private Partnerships, in which DoD Depot Maintenance activities established formal cooperative agreements with defense contractors, became the norm in many system support strategies. DoD maintenance depots benefitted from a natural association between PBL and public-private partnering; these partnerships enabled the best use of both public and private sector competencies, while preserving the vital organic industrial base.

DoD also initiated policies to facilitate life cycle product support management and to raise awareness of the need to bridge acquisition and sustainment communities. Foremost among these was the assignment of the Total Life Cycle Systems Management (TLCSM) role to the DoD Program Manager, making them accountable not only for acquisition of DoD systems, but also planning, implementing, and managing sustainment of the system throughout its life cycle. Other changes in Acquisition and Requirements policy enabled increased focus on a "life cycle" perspective, codifying the "concept to disposal" integration of weapon system acquisition, sustainment planning, and oversight. In the process, DoD began to transform how it develops and supports its weapon systems.

The Military Departments displayed examples of excellence in product support reform. Since 2005, the Secretary of Defense has recognized 18 programs across all Services for excellence in outcome-based product support approaches. There are over 200 examples of performance-based initiatives, with notable examples of success at the component, subsystem, and system levels. The Services have each developed a broad set of Service-specific initiatives and policies based on enterprise-wide product support goals; a sample set is outlined below.

***Figure 2: Significant Service Policy Initiatives in Support of Performance-Based Approaches***




## Product Support Today

Ten years later, the need for reform still exists and the effectiveness of product support is an enduring challenge within DoD. Despite the documented success of many programs, there remain significant obstacles to effective implementation of performance-based, outcome-based strategies, especially when viewed against the 1999 product support reform goals. Notwithstanding the success of performance-based support, 80 percent of DoD product support remains largely transaction-driven. Supply chains are still functionally-driven and maintenance is not fully integrated with the end-to-end supply chain. Supply chain visibility for developed software that is being incorporated into critical DoD systems is particularly troublesome. In spite of ongoing initiatives and progress, the critical need for comprehensive end-to-end total asset visibility has still not been achieved. DoD has emphasized joint requirements and joint strategies,

> Product support has been afflicted by uneven implementation messages and a lack of a consistent, senior leadership-endorsed strategy.

yet few joint sustainment strategies exist. In spite of intense Human Capital improvement efforts, segments of the DoD workforce still make claims of insufficient product support integration knowledge and skills. While the current product support process generally meets military Service readiness standards, it does so while continuing to harbor inherent inefficiencies and higher-than-necessary costs.

More work also needs to be done to foster competition across the Defense industrial base. DoD 5000-series policy emphasizes the power of competition, yet opportunities remain to promote competitive pressures throughout the life cycle. Title 10 requirements hinder the ability to allocate workloads based on best capability and best value. In spite of several efforts, there remains a need to reengineer financial processes to accommodate and enable performance-based sustainment strategies—a major challenge for Program Managers (PMs) charged with responsibility and accountability for life cycle product support.

For the past ten years, life cycle management has been the *strategic* product support framework while PBL has been the *tactical* approach. In the face of a challenging national security threat, PBL provided greatly improved material readiness. While many PBL applications have been implemented over the last decade, most do not meet the key characteristics of a mature PBL or only cover a very small portion of the weapon system; having greater availability on tires or an auxiliary power unit can positively affect Warfighter capability, but that effect may be limited if other subsystems (e.g., avionics or engines) are not similarly availability-driven. The pressure to increase Service numbers of PBL programs has prompted misclassification of product support strategies—traditional transactional contracts with a minor performance incentive clause have been incorrectly labeled as "PBL," resulting in not only inaccurate counts of PBL programs but creating confusion regarding what is, and what is not, a PBL strategy. With this PSAT effort, DoD is committed to gleaning the lessons learned from the past decade with a richer understanding of successful business models for product support. It is now time to examine the lessons of PBL and formulate a path ahead culling the best practices of the outcome-based approach to drive down costs while retaining high material readiness.

## Independent Report Findings and Implications

Independent agencies echo the need for continued product support reform. Acquisition and sustainment processes, areas both spanned by product support, are the subject of continuing scrutiny from outside the Department. In 2003, GAO criticism focused on the requirements development process itself and recommended an outcome-driven life cycle approach.[7] Over the past several years, the GAO has released two reviews of the implementation of PBL, highlighting a set of implementation gaps that must be addressed.[8] The findings of both reports note the need for more robust and ongoing analysis of outcome-based product support results.

The Defense Business Board (DBB) has also taken an interest in product support and, in January 2009, echoed some of the 1999 recommendations. The DBB suggested a key priority should be

[7] Report to the Subcommittee on Readiness and Management Support, Committee on Armed Services, U.S. Senate Best Practices: Setting Requirements Differently Could Reduce Weapon Systems' Total Ownership Costs, GAO-03-57, February 2003.

[8] "Defense Management: DOD Needs to Demonstrate That Performace Based Logistics Contracts Are Achieving Expected Benefits," GAO-05-966, September 2005, and "Defense Logistics: Improved Analysis and Cost Data Needed to Evaluate the Cost-effectiveness of Performace Based Logistics," GAO-09-41, December 2008.

to align the manufacturing and service suppliers with the Department to optimally meet the Department's mission requirements.[9] There have also been significant analyses commissioned by the Services, looking at various aspects of PBL. For example, the Center for Naval Analysis pointed out the need for more PBL contracts to be competitively awarded.[10] In 2008, the USAF, in partnership with the University of Tennessee, completed a review of the current status of PBL implementation across a broad cross section of programs. While some best practice implementations of PBL were seen, and in spite of PBL policy set forth in Air Force Instruction 63-101, in general, the USAF implementations of PBL were deemed inconsistent in scope, impact, and application of best practice.

These are sobering critiques, but they do not challenge the underlying logic or success of performance-based, outcome-driven strategies. Instead, they collectively challenge whether the implementation of the strategy is as effective as it should be. They do not support abandonment of the approach; rather, they identify opportunities to deliver even more powerful results.

### *Supporting Data Analysis*

Previous product support reform efforts have been conspicuous in the absence of supporting data analysis. The PSAT team considered it critical to not only put forward solid recommendations to improve the DoD sustainment environment, but that those recommendations are solidly supported by comprehensive data analysis. Thirty-four (34) separate DoD systems were included in this analysis (see Appendix A for a full discussion of the results). The results were consistent: outcome-based, partnership-oriented strategies consistently provided greater readiness at more affordable cost than traditional, transactional support strategies. The data provides the basis for tangible conclusions and recommendations, versus the subjective proposals offered by many previous studies.

## The Case for Change

As we progress into the 21st century, DoD faces the dual challenges of a persistent expeditionary military presence and a period of enduring conflict. Success in this context is measured by DoD's ability to sustain forces and maintain equipment, while concurrently preserving its ability to display flexibility in meeting the evolving and changing operational conditions of irregular warfare and stateless actors.

Furthermore, the global economic environment and internal competing domestic requirements for scarce resources create an imperative for DoD to do more with less. The reality is that supplemental expenditures will not continue at their current levels indefinitely and, as they diminish, system sustainment will again be a target for obtaining needed cost reductions. If not addressed with well-planned reform initiatives, product support costs can cripple DoD's budget. There will be continued pressure on DoD to reform and to deliver cost-effective product support while accommodating rapid and agile acquisition.

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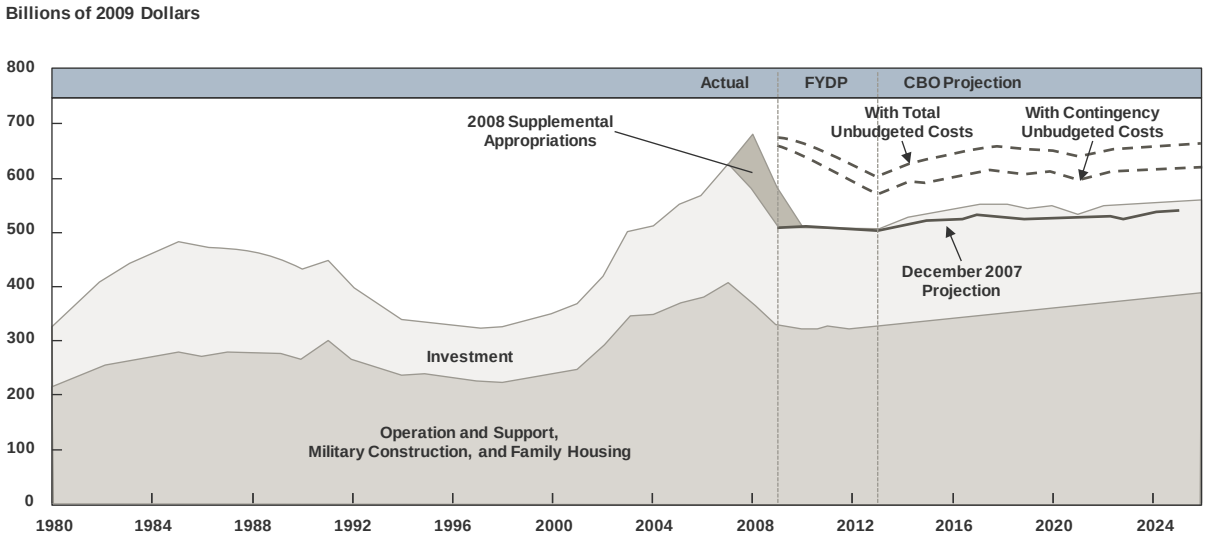
[9] "Focusing a Transition: Key Priorities for the Senior Leadership," January 2009.

[10] Cost and Performance Characteristics of Navy Performace Based Logistics (PBL) Contracts. Ronald H. Nickel, Glenn Ackerman, Brent Boning, Tom DePalma, Craig Goodwyn, and Rebecca Kirk, Center for Naval Analysis, 12 November 2008.

***Figure 3:[11] Defense O&S Needs Keep Growing and are Likely to Grow Beyond DoD's Capacity to Meet Them***




Source: Congressional Budget Office

DoD also faces a new economic and political environment. Consequently, the Department can anticipate significant financial compression and a mandate to lean itself. Based on current and projected financial realities, the administration is effectively adopting a zero real-growth policy in the DoD base budget.[12] However, in Figure 3, current Congressional Budget Office projections show the gap between historical and projected DoD budgets and the Department's appetite for resources.

DoD's appetite for resources has not lessened. Personnel cost growth has historically averaged 1 percent a year and operations and maintenance (O&M) cost growth has averaged 2 to 3 percent per year.[13] This is not a new development. The DoD Cost Assessment and Program Evaluation (CAPE) organization—formerly DoD Program Analysis and Evaluation (PA&E)—has similar figures dating back to 1968, showing the same trends for over 40 years. Various base realignment and closure (BRAC) rounds, acquisition reform initiatives, and other sustainment costs reductions have not been able to effectively control these costs. This may cause resources for acquisition of new weapons systems to become increasingly scarce in the long term.

Finally, the DoD organic base cannot and does not perform the entirety of product support work. American Industry has been a vital component of the national security capability since the Revolutionary war, and through all wars and conflicts that have followed. The "great arsenal of democracy," as characterized by Franklin Roosevelt, is a source of innovation and productive capacity for the military force. Yet over 60 years after the modern day Defense Industry emerged following World War II, DoD still fails to fully leverage the knowledge, skills, and capabilities of the government organic and industry defense-industrial base through a considered and integrated strategy. For example, DoD's increasing reliance on foreign suppliers offers expanded capability—and risks—heretofore not understood nor addressed. In a time of increasing service

[11] Congressional Budget Office. "Long-Term Implications of the Fiscal Year 2009 Future Years Defense Program," January 2009.
[12] O'Hanlon, Michael. "Obama's Defense Budget Gap." *Washington Post* [Washington, DC] 10 June 2009.
[13] Adjusted for inflation.

life for deployed weapon systems, spiraling cost estimates for scheduled acquisitions, there is a clear need for innovation to provide more accurate life cycle planning, more affordable product support, and more effective delivery of readiness to the Warfighter. Outcome-based and integrated partnering strategies provide the opportunity to effectively optimize existing military assets, retire excess assets, and provide much needed relief from continuing budgetary pressure.

## Conclusion

The national security and economic environments dictate tough-minded acquisition reform and logistics transformation. The challenges of affordability constraints, the need to reset equipment and infrastructure, and a continuing, persistent operations tempo prescribe 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 measured by a reduction in costs while maintaining equal or greater equipment readiness supporting required warfighting capabilities. As DoD moves forward with acquisition reform and improved life cycle management practices, product support improvement is at the nexus of these critical efforts.

The recommendations included in this report promote the implementation actions necessary to significantly improve product support capabilities and affordability.

# Chapter 2: Management and Analytical Approach

## Purpose and Membership

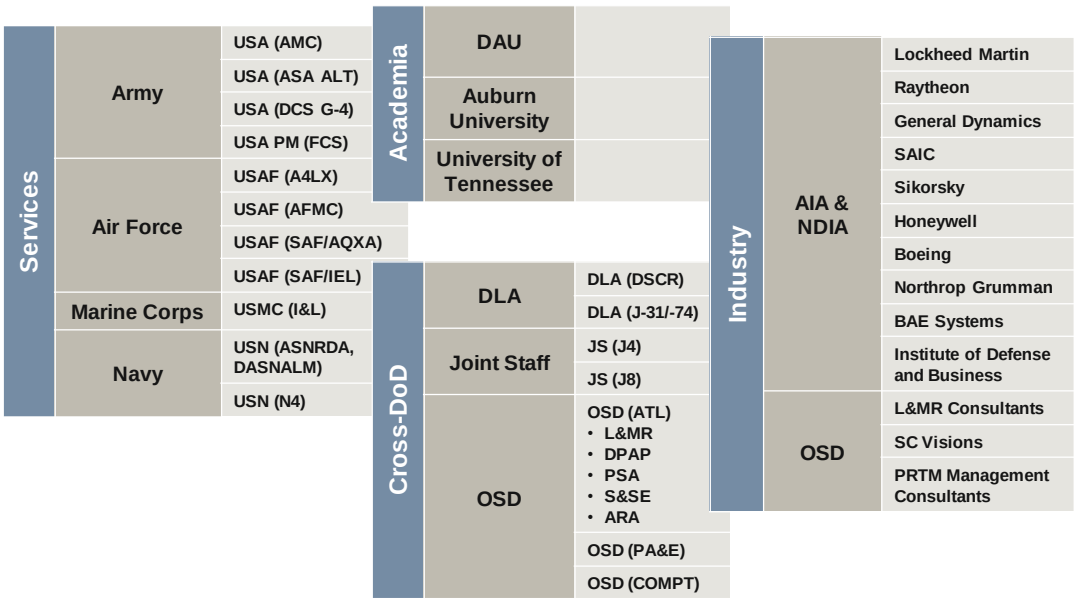
In September 2008, a DoD Product Support Assessment Team (PSAT) was formed to analyze DoD product support enterprise activities, performance, and cost and to outline actions to improve life cycle product support management.[14] The team was also tasked to assess overall and program-specific progress in capturing, managing, and improving weapon system support costs while maintaining necessary readiness levels and mitigating sustainment risk.

The PSAT's first-year goal was to produce an informative and actionable report for OSD, the Military Services, Defense Agencies, and Congress. Specifically, the report would document:

- Current state of product support across the DoD enterprise
- Specific product support-related topical and weapon system analysis
- Areas within product support that need improvement
- Recommended actions, integrators, and enablers necessary to improve the selected areas
- The next generation of life cycle product support in a model that integrates and enables improvements
- Findings, recommendations, and an initial implementation plan

In designing the PSAT structure, great care was taken to recognize the benefits of diversity and wide representation. PSAT Working Group (WG) members consisted of representatives from government, industry, and academia as illustrated below.

***Figure 4: Working Group Representative Organizations***




[14] U.S. Department of Defense, Deputy Under Secretary of Defense for Logistics and Materiel Readiness, *Product Support Assessment Team* Memorandum, 05 September 2008.

A Senior Steering Group (SSG) chaired by the ADUSD (MR) governed and guided the overall PSAT process, findings, and recommendations. Members of the SSG, as shown in Figure 5, consisted of flag-level and senior government officials and leaders from industry and academia.

***Figure 5: Senior Steering Group Representative Organizations***

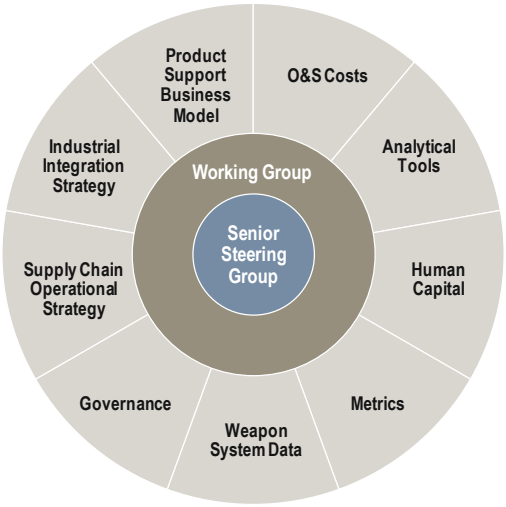
| Senior Steering Group | |
|---|---|
| United States Army | Director, Acquisition Resources and Analysis |
| United States Navy | Director, Defense Procurement, Acquisition Policy and Strategic Sourcing |
| United States Air Force | Director, Systems Engineering |
| Director, Defense Logistics Agency | Director, Portfolio Systems Acquisition |
| Vice Director for Logistics, Joint Staff, J4 | AIA |
| Director for Force Structure, Resources, and Assessment, Joint Staff, J8 | NDIA |
| USD (Comptroller) | ADUSD (MPP) |
| Director, Cost Assessment and Program Evaluation, CAPE | ADUSD (SCI) |
| ADUSD (MR)—Chair | |

Finally, selected PSAT members, along with invited stakeholders and subject matter experts (SMEs) from the product support community, formed Recommendation Build Teams (RBTs) according to the eight priority recommendation areas chosen by the PSAT WG and approved by the PSAT SSG.[15] The RBTs reported results to and received feedback from the WG.

Throughout the process, the teams maintained a procedural discipline that encouraged an open mindset, active listening, transparent and rational decision making, equal opportunity to influence decisions, and an agreement that consensus would dictate the outcome. The internal PSAT management structure, including RBTs by recommendation area, is included in Figure 6.

[15] An additional RBT was formed to support the weapon system data collection and analysis effort. Weapon system analysis results were also reported to the Working Group.

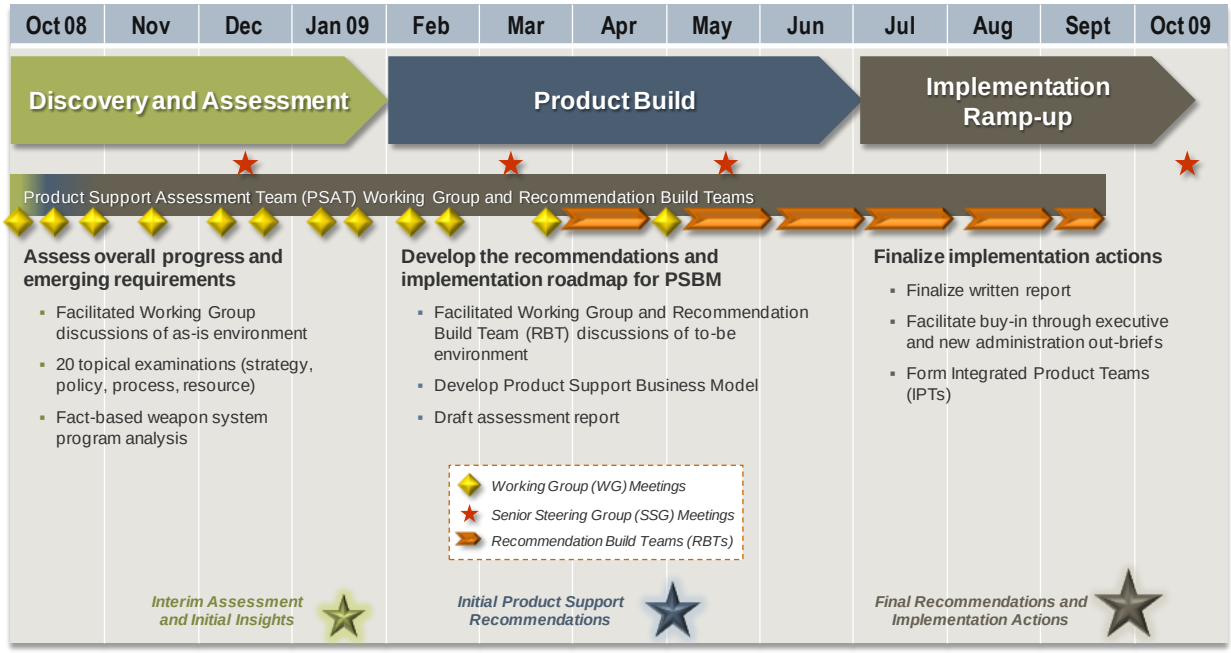
*Figure 6: Product Support Assessment Team Structure*




## Approach and Methodology

The PSAT effort was divided into three separate phases: Discovery and Assessment, Product Build, and Implementation Ramp-up. The timeline, primary activities, and key milestones are highlighted in Figure 7 and discussed below.

*Figure 7: PSAT Project Plan with Key Activities and Milestones*



### *Discovery and Assessment*

The key focus for the four-month Discovery and Assessment phase was to first conduct an "as-is" assessment of the current product support environment, and then create a vision and guiding principles for product support going forward.

To conduct an "as-is" assessment, the larger PSAT WG examined approximately 20 product support topics, which were eventually grouped and investigated under eight broader topics: Milestone Reviews, End-to-End Alignment, Cross-Service Alignment, Customer-Facing Metrics and Performance Outcomes, Internally-Facing Metrics and Performance Outcomes, Business Case Analyses, Legislative Environment, and Partnering Strategy.

The methodology used to examine these topics was to approach them from four different investigative perspectives:

1. *Policy*: Is *policy* adequate to successfully drive desired behavior for total life cycle product support?
2. *Strategy*: Is there a useful, consistent, understandable, and executable *strategy* for life cycle product support?
3. *Processes*: Are *processes* sufficient and aligned to enable accurate, consistent life cycle product support?
4. *Resources*: Are *resources* (people, skills, funding, data, IT tools, training) adequate and appropriate to conduct and support effective life cycle product support?

The larger WG of 45 members broke into four sub-teams and deconstructed each topic in these ways, deriving both a qualitative and a quantitative current-state assessment of the eight topics.[16]

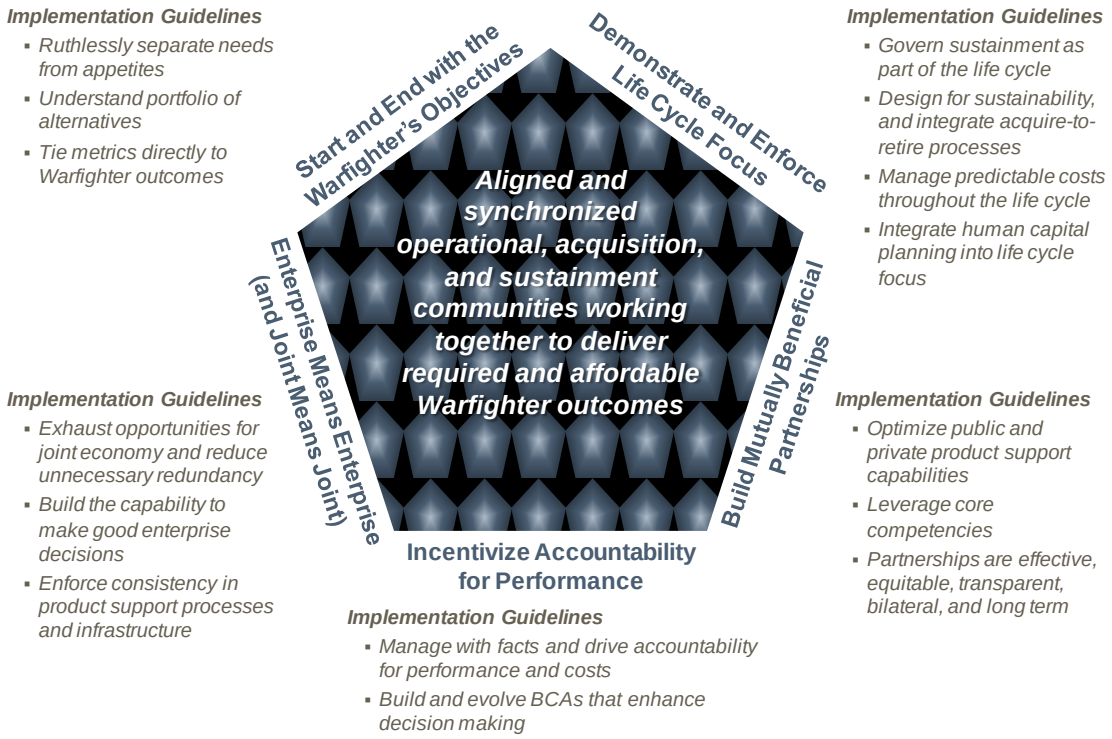
Results from this assessment validated *Resources*[17] as the area with the most significant gaps in terms of its ability to meet life cycle product support requirements at current maturity. There was a consensus among PSAT members that current product support strategies have not always been effectively or resourced. For example, it is difficult to quantify the effectiveness of financial resources because their measure is based on a lack of consistent, useable data. Lack of consistent, useable data is further caused by a failure to acquire data, inconsistent reporting, and a lack of data documentation requirements.

Understanding the current state of product support provided the baseline for PSAT members to establish the Vision and Guiding Principles for product support going forward. These are illustrated in Figure 8.

[16] The teams also conducted a quick look of what product support gains could be achieved on a particular topic in five years. The purpose of this "to-be" exercise was to understand where product support could capture realistic and quick wins in the near future.

[17] Where *Resources* are "people, skills, funding, data, IT tools, and training."

*Figure 8: The Life Cycle Product Support Vision and Guiding Principles*




The PSAT WG developed a future product support vision that emphasizes aligned and synchronized operational, acquisition, and sustainment communities working together to deliver required and affordable Warfighter outcomes. Guiding principles collectively channel the next generation of product support actions into a cohesive action plan to support the vision. This vision and set of guiding principles is supported by a set of implementation guidelines for cohesive and coordinated action.

During the Discovery and Assessment phase and concurrent with analysis performed by the WG, PSAT analysts conducted a weapon system data assessment effort to gain a better understanding of (1) which product support strategies lead to improved readiness and (2) which practices better support the Warfighter in terms of materiel availability per sustainment dollar spent. The Services provided data and analytical insight for 34 weapon systems.[18]

### *Product Build*

During the five-month Product Build phase, the WG evolved in purpose and structure from an "assessment" body into a "recommendation" body. To accomplish this role, the restructured WG assessed the gaps documented in the Discovery and Assessment phase and developed recommendations to close those gaps.

Initially, the WG identified over 100 recommendations for improving life cycle product support. The SSG, after reviewing the initial recommendations, directed the WG to develop a smaller number of focused, overarching recommendations. In response, the WG identified eight priority

[18] The weapon systems assessment and outcomes are described in detail in Appendix A.

recommendation areas that would undergo further analysis to determine root cause problems and develop tangible actions to resolve issues and achieve the transformation objectives. These areas were:

- Product Support Business Model
- Industrial Integration Strategy
- Supply Chain Operational Strategy
- Governance
- Metrics
- O&S Costs
- Analytical Tools
- Human Capital Strategy

To facilitate deep-dive analysis on these recommendation areas, selected PSAT members and product support SMEs formed four- to eight-person Recommendation Build Teams (RBTs). A weapon systems performance and cost data RBT was also established to formally elicit Service and stakeholder participation in providing weapon system data and in interpreting analytical findings.[19]

The recommendations outlined in this report were derived from the RBTs' root-cause analysis, which consisted of an end-to-end assessment of the top-eight priority recommendation areas. The root-cause analysis is summarized below.

## Root-Cause Analysis

### Continued Reliance on Transactional Systems and Processes

Many of the existing systems and processes have been designed for transactional logistics. Current systems and processes do not provide the necessary data and functionality to measure and manage outcome-based sustainment. As a result, DoD lacks the capability to accurately assess the cost and cost benefits of various product support strategies. Furthermore, DoD has difficulty confirming cost benefits to the satisfaction of independent overseers.

### Inadequate Human Capital

Government human capital resources have been slow to develop the knowledge and skills necessary to plan, implement, integrate, and manage complex outcome-based product support strategies. While there are examples of very good progress in this area, DoD lacks an adequate across-the-board foundation of qualified sustainment managers equal to the product support challenge. Industry, benefitting from its commercial sector experience, has exhibited better capabilities in this regard. Also, over the last two decades, the Department has outsourced some product support functions, supply chain management, technical data management, configuration management, and sustaining engineering. Where high levels of product support expertise do

[19] Each of the eight priority areas is discussed in detail in Chapters 3 and 4, and the weapon system analysis is discussed in Appendix A.

exist, it is often functionally-focused, which matches the organizational culture of many Defense logistics organizations.

### Need for Smart Managers and Smart Buyers

There is a need for better-informed customers that can perform as either efficient managers of product support or as "smart buyers" of product support services, thus encouraging more responsive and responsible suppliers.

In addition, Warfighters are too often organizationally removed from both the acquisition and product support communities, leading to product support solutions that are neither responsive nor cost-effective enough to affordably meet changing operational priorities.

Recommendations are derived from root-cause analysis on major product support issue areas. In summary, these root causes are:

- Antiquated systems and processes
- Inadequate human capital
- Need for "smart buyers"
- Organizational challenges
- Lack of shared goals

### Organizational Challenges

There are significant organizational challenges associated with improving product support. These challenges reflect alignment gaps from a life cycle (concept through disposal) perspective, a joint (cross-Service and cross-Agency) perspective, and a government-industry perspective. Currently, the Department's organizational and governance structure has been unable to fully embrace performance-based, outcome-oriented opportunities or a holistic closed-loop process for improved enterprise decision making.

At the program level, some Program Managers have not been properly equipped to fully assume and execute total life cycle management responsibilities. The organic product support structure is organized on a functional basis (e.g., supply, maintenance, and engineering), often precluding (1) decision making based on an integrated view of all relevant product support elements and (2) effective tradeoffs among those elements to achieve the optimum outcome.

### Lack of Shared Goals

The functional stovepipes that exist between the acquisition and sustainment communities are ultimately rooted in organizations that are funded separately and lack incentives for shared goals and financial transparency. In addition, the current guidance and vision for PBL has not proliferated across the logistics community. There are uniquely different product support strategies and interpretations of "performance-" or "outcome-based" approaches across DoD.

## *Implementation Ramp-up*

The final phase of the effort, Implementation Ramp-up, involved team consensus of the product support recommendations, refining the written report, and a high-level, first-draft implementation plan. The RBTs continued to serve as the primary vehicle for achieving project work, with the WG serving as a reviewing body for RBT-generated products.

In the future, RBTs will evolve into Integrated Product Teams (IPTs), formed to drive the initiatives recommended in this report to realization.

# Chapter 3: Next-Generation Business Model for Life Cycle Product Support

This chapter explains the characteristics and framework of a new DoD business model for improving product support. It provides a requirements overview, explanation of the design, a summary of how it can be applied, and further steps to ensure its successful implementation.

The current and future environment requires a significant change in the way DoD makes and executes product support decisions. As described in Chapters 1 and 2, resource constraints and dynamic operational requirements continue to exacerbate product support challenges. Product support is extremely complex and requires integration of the full range of stakeholders and processes crossing civilian, military, political, financial, industrial, academic, and multinational boundaries. Individual weapon system product support outcomes are an imperative, but they should capitalize on efficiencies available through commodity and enterprise management approaches. Cross-functional and cross-Agency teams need a central focus on enterprise objectives but a decentralized execution construct to achieve desired weapon system outcomes. This requires moving beyond functional excellence to portfolio and platform excellence. The best solutions can no longer rely on functional stovepipes. They require an integration of the best suited participants to create hybrid organic and commercial capability to effectively and affordably deliver Warfighter-based outcomes.

This new focus changes product support strategy, processes, policy, and resourcing to achieve the appropriate balance of weapon system capability, total ownership cost, and risk to deliver optimum value. While there are other factors affecting these elements, product support decisions are clearly a major cost driver and readiness-influencing factor throughout the product life cycle. Accordingly, the PSAT recommends a new business model that will improve the product support execution and decision-making processes.

***Recommendation:*** Adopt a "product support business model" that drives cost-effective performance and capability for the Warfighter across the weapon system life cycle and enables the most advantageous use of an integrated defense industrial base.

## Requirements of the Product Support Business Model

A typical business model looks at the business logic of a company from its internal and external perspective. It includes client interfaces, revenue streams, cost structures, and the necessary value chain to execute and implement a business. A DoD business model provides a representation of how DoD intends to provide a valued product or service. In this case, that product is ***optimized product support through balancing maximum weapon system availability with the most affordable and predictable total ownership cost***.

Requirements for this new business model were developed using the life cycle product support vision and guiding principles, standard business model characteristics, and PSAT findings. These sources concluded that the business model must:

- Focus on affordable Warfighter outcome-based objectives
- Enable fact-based decisions supported by data

- Use lessons learned over the last decade to evolve and improve on Performance Based Logistics (PBL)
- Be compliant with statutes and policy (subject to recommended changes)
- Provide usable information that is integrated in logistics enterprise, planning programming, budgeting and execution (PPBE), Defense acquisition and operational decision making
- Identify and assign actions, roles, responsibilities, and standards of performance that facilitate collaboration and partnering
- Capitalize on the extensive organic and commercial defense industrial base
- Be flexible and responsive to address emergent warfighting requirements
- Utilize a toolbox of product support options

The product support business model (PSBM) should help requirement generators, Program Managers, Department logisticians, industrial base members, and policy makers work together to make and implement more informed life cycle product support decisions. This requires a common focus to balance a tridimensional combination of cost, risk, and capability, thereby creating the value proposition of an affordable level of outcome-based performance. The difference between the capability requirement and capability that can be achieved with available resources creates risk. Throughout a program's life cycle, decisions will involve making trades between capability, cost, and risk. Although programs have known and frequently document product support risk, it is seldom acknowledged in a substantive, problem-solving way.

> Program support risk is driven by a number of different variables, including system performance variance, unplanned operational environment, changing economic situations, and availability of resources.

The ideal situation would be steady state, where resources are adequate to fully support requirements. The reality is this rarely occurs; requirements consistently exceed available resources. The uncertain environment creates dynamic capability, capacity, and resource requirements. Competing demands for limited resources, consistent schedule pressures, time-phased value of money, and type-of-funding availability also add to the complexity.

The ability to choose wisely among the alternatives requires a culture that is focused on delivering performance (outcomes) and manages by facts. The business model must provide the mechanism to measure, assess, and compare performance outcome, cost, and risk objectives to make informed programmatic through-life decisions.

Weapon system support improvement is a continuous journey that will use an iterative approach for refining processes, adapting to changes, and eliminating obstacles. It must capitalize on best practices and provide a closed-loop feedback process. Therefore, the proposed model should incorporate lessons learned and success stories from DoD's experience with PBL, contractor logistics support, public-private partnerships, performance-based agreements, and other sustainment solutions over the last decade.

Product support decisions have a direct impact on Warfighters and the operational planners. The model must enable military departments to meet their unit-centric support outcomes, and generate sufficient unit availability, reliability, and affordability. This requires acknowledgement and incorporation of the way Warfighters execute their mission via the Brigade Combat Team

(USA), Carrier Battle Group (USN), Expeditionary Air Wing (USAF), or other unit-centric mechanisms. History is replete with examples of how logistics wins or loses wars. Product support constitutes approximately 70 percent of logistics cost[20] and, while cost alone should not dictate Warfighter decisions, the elements that drive product support cost undoubtedly have an impact on a Warfighter's freedom of action. In addition to the logistics footprint, there is an opportunity cost—every dollar spent on support could be spent elsewhere. While the objective may be individual system performance, the model cannot ignore the economies of scale and efficiencies that can be harnessed by consolidating like items for an enterprise or commodity management approach. The model must be designed to not only address specific program decisions, but also provide information that is integral to logistics enterprise and operational decision making.

> Understanding, integrating, and capitalizing on the value each organization brings is a tough product support challenge.

The magnitude and scope of product support involve many disciplines, perspectives, and organizations. Rarely does one find a more diverse group that can produce such significant value. But, this group faces tough challenges in achieving efficient integration within the boundaries of statute, policy, guidance, and historical paradigms. Orchestrating this effort is a monumental task and begins with defining clear roles, responsibilities, and standards of performance. The business model must articulate, leverage, and communicate competencies to help create effective, equitable, and transparent relationships based on common Warfighter-desired outcomes. That includes private industry as emphasized by AT&L leadership:

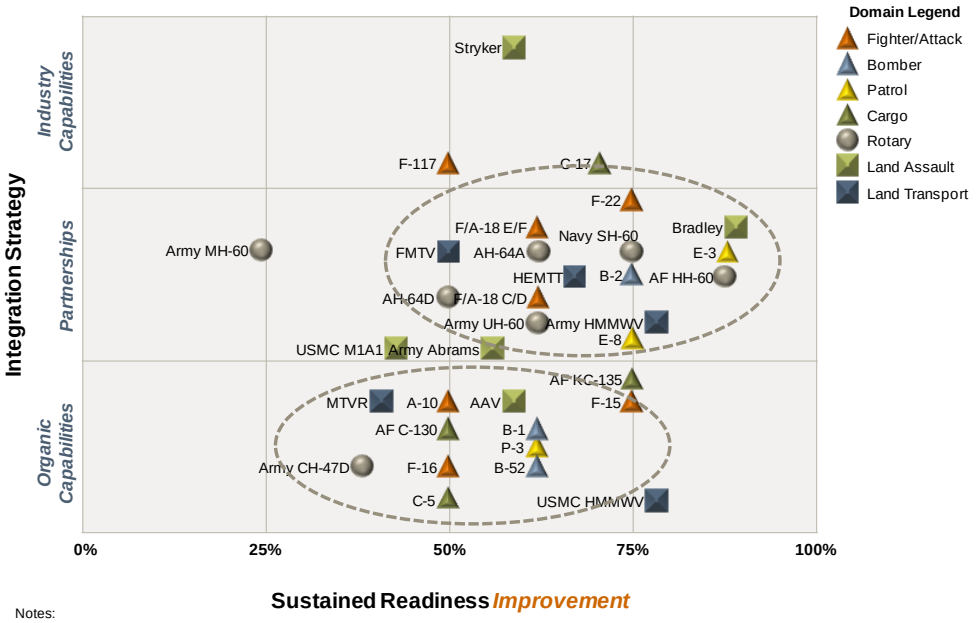
> *"In our country we buy our military equipment from private industry, so they're our partners in equipping our forces…I would like to have a relationship of candor and dialogue…we're in this together."*[21]

The PSAT weapon system assessment reinforced the potential that partnering strategies can produce higher sustained readiness improvement as shown in Figure 9.

[20] See Appendix D for details.

[21] Ashton Carter, Under Secretary of Defense for Acquisition, Technology and Logistics, *The Wall Street Journal*, 01 May 2009.

***Figure 9: Partnering Strategies Produce Higher Sustained Readiness Improvement***




Notes:
1. Sustained Readiness Improvement is the number of years over the span of 1999 through 2007 where a weapon system saw no decline in availability or saw a decline of lesser magnitude than the domain average
2. F-22, FMTV, MTVR, and Stryker data does not span from 1999 through 2007 due to their newness
3. USAF C-130 APU contract awarded to Honeywell in August 2007—not enough time has occurred yet to include it as a partnership for this evaluation

Rapid technology changes and emerging threats necessitate a more flexible and responsive product development, sustainment, and retirement system. As an example, the threats imposed by Improvised Explosive Devices (IEDs) highlight the Department's need to rapidly develop and field new systems to counter and protect against these threats. The urgency of fielding new solutions can understandably overshadow support and sustainment considerations, resulting in less-efficient support and higher life cycle costs. Supportability decision tools must be embedded in the new product development process to influence design for support while not hindering the timely fielding of critical systems.

Defense Secretary Gates, in a speech at the Economic Club of Chicago, Chicago, Illinois, on 16 July 2009, noted his concern over the Department's ability to respond to irregular warfare and support rapid acquisition.

> *"During this period there were important changes in the way U.S. forces were organized, based and deployed, and investments were made in new technologies such as unmanned aerial vehicles. However, when all was said and done, the way the Pentagon selected, evaluated, developed, and paid for major new weapons systems and equipment did not fundamentally change - even after September 11th. Indeed, the kinds of equipment, programs, and capabilities needed to protect our troops and defeat the insurgencies in Iraq and Afghanistan were not the highest priority of much of the Defense Department, even after several years of war."*

Clearly, the new product support business model must be flexible and responsive to an emerging threat environment. This flexibility should also reside at the other end of the product life cycle with rapid retirement of unaffordable and obsolete systems. The model must provide a better means to evaluate effective trades between keeping existing systems alive or investing in new ones.

A product life cycle support strategy is not a one-size-fits-all solution, though the model used to determine its course can be, so long as it is designed to be enduring, flexible, agile, and actionable. The model must include a standard lexicon, measures, methods, documentation, and tools to make the full range of product support decisions: detailed metrics, integrator selection rationale, roles and responsibilities, incentives, contracting approach, and analytical approaches to accelerate program design, acquisition, and implementation.

### Defining the Product Support Business Model

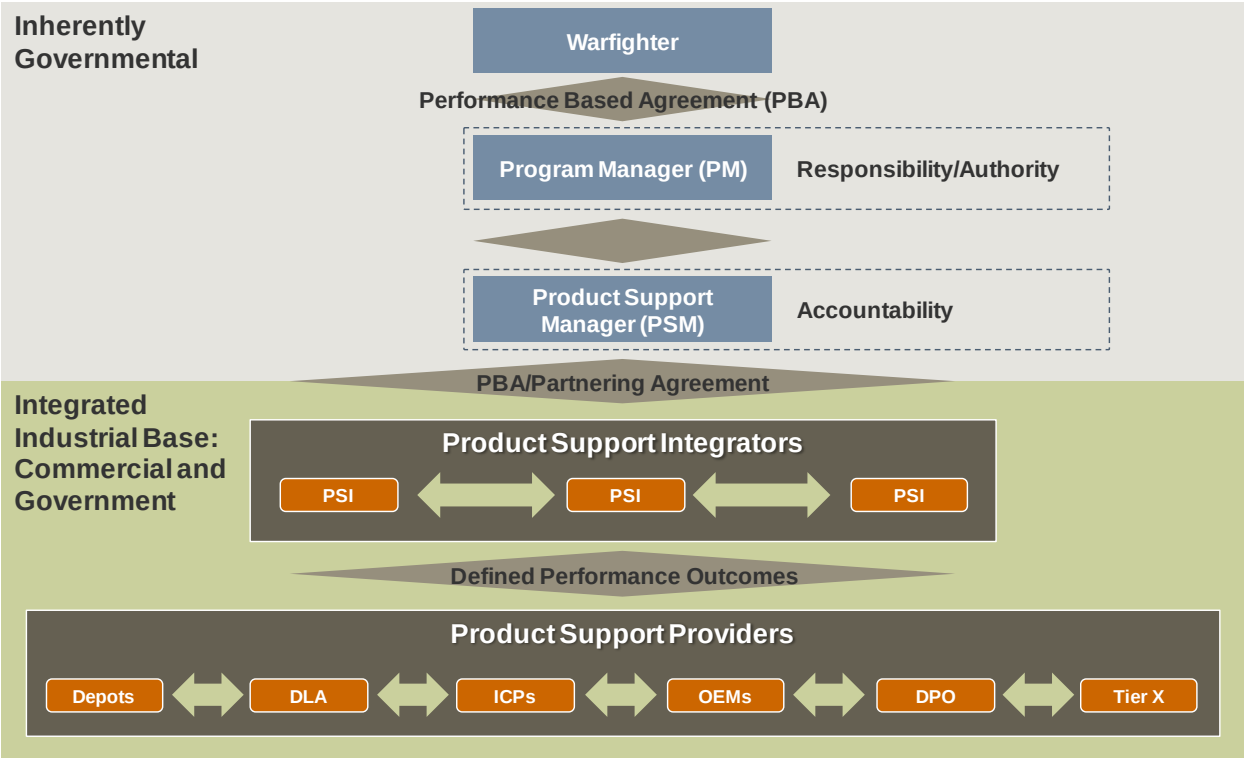
The PSBM encompasses the overall strategy for product support planning, implementation, management, and measurement over the life cycle of a weapon system component, subsystem, or platform. It is designed to fulfill the requirements discussed above and looks forward to address future opportunities for creating expanded partnerships, incentivize the organic sustainment community, and manage long-term affordability.

PSBM provides:

- Opportunity for horizontal and vertical trades in cost, capability, and risk
- Clear lines of accountability, responsibility, and integration
- Emphasis on improved communication and information sharing
- Continued emphasis on outcome (performance) based strategies

One of the consistent weaknesses of the current product support environment is the lack of a well-defined model in which the various roles, responsibilities, relationships, and accountability among the managers, integrators, and product support providers have been delineated. Figure 10 provides the new business model's framework in which these elements are portrayed in the overall structure for planning, developing, implementing, and accomplishing sustainment over the life cycle. Concurrent with the delineation of roles, the model also portrays the implementing of Performance Based Agreements (PBAs), which enable the relationships between entities.

*Figure 10: The Product Support Business Model Is a Hierarchical Level of Functions Integrated with PBAs*




The top tier of the framework designates the inherently governmental functions of developing and managing the overall product support strategy across the life cycle, beginning with the Warfighter's performance requirements. The Program Manager has the responsibility to develop an appropriate sustainment strategy to achieve effective and affordable operational readiness consistent with the Warfighter resources allocated to that objective. The PM's responsibilities for oversight and management of the product support function are typically delegated to a Product Support Manager (PSM[22]) who leads the development, implementation and top-level integration and management of all sources of support to meet Warfighter sustainment and readiness requirements. This top-level government role is crucial to the delivery of not only system-level, but also portfolio- and enterprise-level capabilities across the spectrum of defense resources.

The framework's bottom tier portrays the product support-implementing agents. Consistent with the model's emphasis on a performance-/outcome-based product support approach, there is a requirement for one or more Product Support Integrators (PSIs) who are chartered with integrating sources of support, public and private, defined within the scope of their implementing agreements, to achieve the documented outcomes. There is a clear need for entities (public or private) to be assigned the responsibility for delivering performance outcomes, to be endowed with authority to integrate, manage, and provide oversight over the lower level support functions that, in combination, achieve the specified outcomes. The PSI role is assigned within the scope (component, subsystem, or system level) designated by the PSM and is performed under the

[22] Here, PSM is an overarching term characterizing various Service function titles: Assistant Program Manager for Logistics (APML), Deputy Program Manager for Logistics (DPML), System Sustainment Manager (SSM), etc.

direction and oversight of the PSM. The PSIs accomplish their product support role through use of lower-level Product Support Providers (PSPs), which, per the business case analytical assessment process and consistent with statute and policy, are assigned responsibilities to perform and accomplish the foundation functions comprising the product support for the objective capability (enterprise, portfolio, system, subsystem, component). The PSPs comprise the range of best value (or statutorily designated) entities-assigned workloads that achieve the Warfighter support outcomes.

> Performance Based Agreement (PBA) is a generic term representing the range of implementing agreements, such as contracts, Memorandums of Understanding (MOUs), Memorandums of Agreement (MOAs), Commercial Service Agreements (CSAs), Service Level Agreements (SLAs), and similar formal agreements to ensure performance expectations (on both sides) are clearly articulated.

The foundation documents that enact and implement the relationships across this framework are PBAs. It begins with the Warfighter (user) defined performance requirements that are initiated through the Joint Capabilities Integration and Development System (JCIDS). The PSM (acting on behalf of the PM) incorporates the appropriate needs and constraints in agreements with PSIs. They, in turn, ensure that the necessary performance requirements to meet their agreements are properly passed to the lower-tier PSPs, who accomplish the product support activities.

The model should not be interpreted as allowing any product support solution. Rather, it should be interpreted as meaning a thoughtful approach to product support solution design is required and that this approach appropriately balances life cycle readiness and cost. This approach's resultant analysis will result in several solutions with elements that reside in various cells of the Decision Matrix for Product Support shown in Figure 11. The locus of these solution elements will depend on where in the life cycle the system resides, the maturity of the commercial and organic industrial base supporting the system, and on the needs of the individual Services using and supporting that system.

The model and accompanying text represent a simplified explanation of a very elaborate and complex value chain. The model illustrates the range of roles and relationships that develop, manage, and accomplish product support. Although the hierarchy focuses on the down-flow of requirements, it enables a feedback loop in which actual performance data and other information can be used to improve overall product support and performance. This also provides an indicator when trade-off decisions between cost, performance, and risk may be necessary. Like any chain, its strength is determined by its weakest link. The communication requirement strengthens the links and should be included in the PBA. Chapter 4 discusses how the adoption of a Joint Supply Chain Architecture provides standard metrics and lexicon for consistent measures and communication at all levels of the supply chain.

> Good communication, common goals and reliable decision-making data cannot be overemphasized because any element in this chain can impact overall performance.

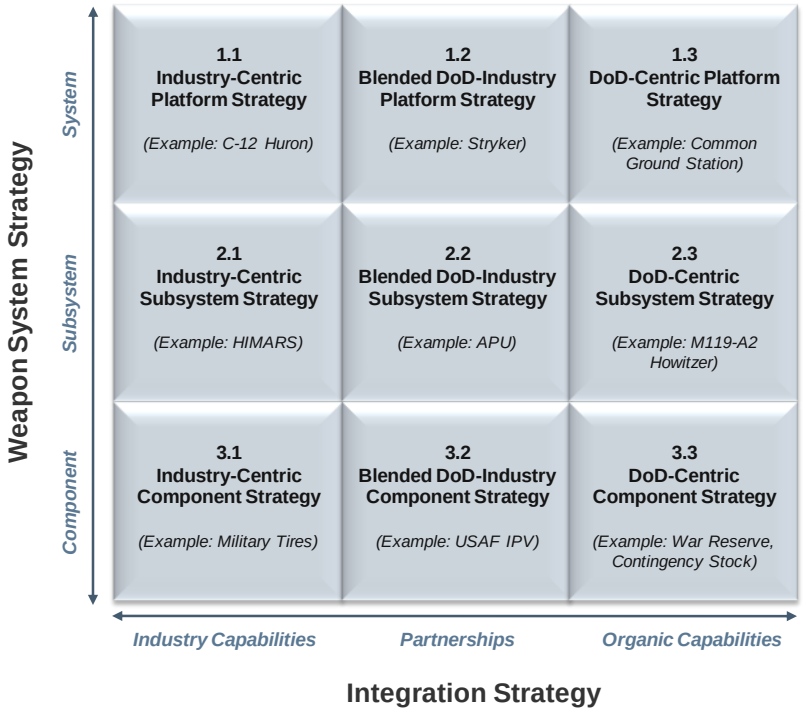
The Decision Matrix for Product Support (DMPS), Figure 11, assists Program Managers in identifying their product support strategy, which drives decisions on PSI composition, metrics, incentives, PBAs, and analytical tools. The matrix is based on a framework that outlines nine

product support options as defined by the intersection of two key strategic system characteristics that drive the appropriate support strategy:

1. **Weapon system strategy**—focused on the level at which sustainment outcomes are measured and managed: platform, subsystem, or component
2. **Integration strategy**—focused on the desired (or required) industry, organic, or partnership capabilities

The following is the overview of the DMPS options framework:

***Figure 11: Decision Matrix for Product Support—Options Framework Examines the Intersection of Integration and Weapon System Strategy***




Each of the product support options in this model has been designed to address applicable product support scenarios within a context of outcome-based, industry-government collaboration. This framework provides a decision tool to support selection of the most appropriate product support approach. A key attribute of the model is the integration of organic and industry roles under the umbrella of performance-based, outcome-oriented approaches to product support. For each product support option, "implementation elements" have been developed, which provide the guidance for designing, building, and managing weapon system programs. Below is an example of these implementation elements. More detail on these support elements are provided in Appendix C.

*Figure12: Implementation Elements Example—Option 2.1 Industry-Centric Subsystem Strategy*

| | |
|---|---|
| **Target Metrics (Outcome Objectives)** | Materiel availability, materiel reliability, cost, and/or additional high-level "driving" metrics to achieve Am and/or Rm, i.e., NMCS, ready for tasking, mission capable rate, etc. |
| **Representative Example Rationales** | Strong OEM/industry capabilities in areas of supplier base, technical data, supply sourcing, sustaining engineering, and production/upgrade capabilities; focus on product improvement and cost reduction. Ability to partner with organic industry base IAW core capability requirements and best-value analysis |
| **Product Support Roles** | Supply chain management, tech support, engineering support, maintenance and repair, support equipment, information systems, configuration management, and training facilities |
| **Government and Industry Incentives** | Leverage commercial expertise and value; utilize government capabilities where clear best value |
| **Product and Support Integration** | PSI accountability and responsibility for delivering outcomes, utilizing industry responsibility for selected activities and outcomes |
| **PBA Approach** | Strong consideration of firm fixed price/fixed price per unit of operation contracts for mature legacy subsystems. Use of cost-plus incentive contracts phasing toward fixed price with less mature subsystems. Incentives (award term, incentive fee) tied to achievement of target metrics/outcomes |
| **Analytical Tools Approach** | BCA, equal or better-value proposition |

## Applying the Product Support Business Model

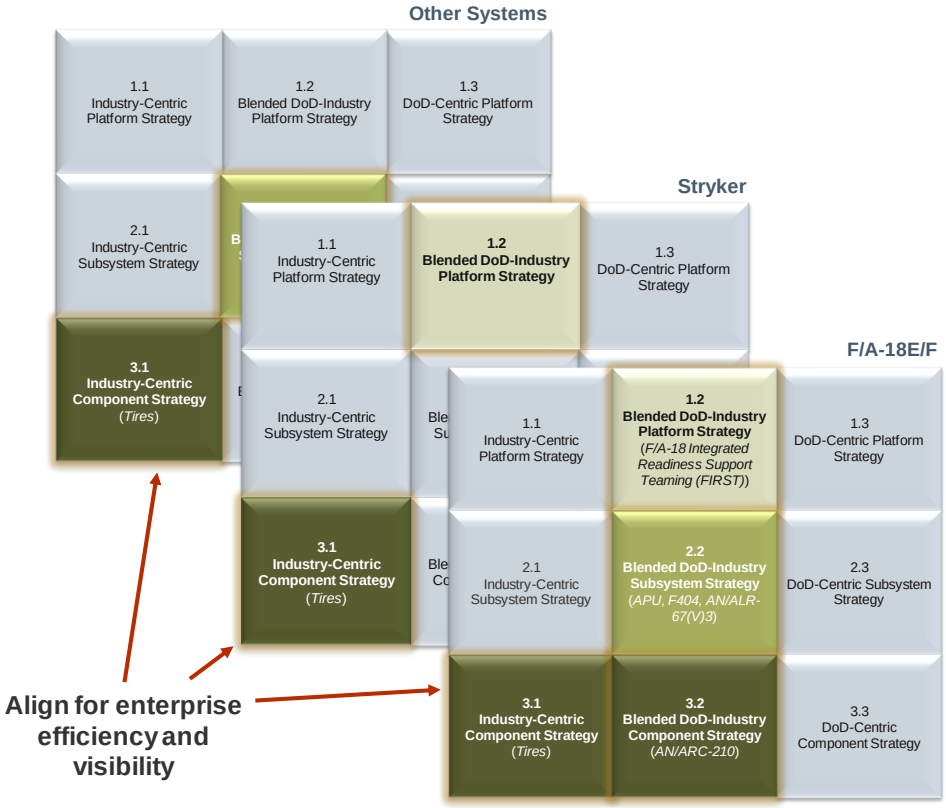
As shown in Figure 12, the PSBM and the DMPS are a means to evaluate and compare support options over the life cycle of a weapon system. They provide considerations for metrics, best practices, roles, incentives, analytical approaches, and processes to help accelerate program design, performance agreements, and implementation.

The approach is not prescriptive. Each of the Services must adapt the overall parameters and selection criteria in the context of its individual and unique product support requirements, legislative and financial constraints, and weapon system performance goals.

## Managing Enterprise Product Support Portfolios

In addition to making program-specific decisions, the PSBM provides a framework for managing product support portfolios across programs, common subsystems, and commodities (e.g., propulsion, fire control, etc.). Figure 13 illustrates the ability for horizontal integration. Although the immediate objective is weapon system performance, there are considerable economies of scale that can be obtained through enterprise- and commodities-based management. By capitalizing on these opportunities while maintaining weapon system accountability, DoD can increase its effectiveness and gain efficiencies. Chapter 4 outlines how the PSBM is supported by operational strategies in supply chain management and industrial integration. These are two examples of potential portfolio opportunities for cross-platform, cross-Service, and cross-industry efficiencies.

*Figure 13: Opportunities Exist for Commodity and Enterprise Product Support Management*




By looking across the supply chain and weapon system portfolios, PMs and Service logisticians have an approach to identify and capitalize on opportunities for enterprise visibility and efficiency, resulting from the common management and aggregation of components and common subsystems, as depicted by Option 3.1 in the diagram above.

## Implementation Actions

The new PSBM provides a catalyst for improving weapon system availability while focusing on total ownership cost. This is only the beginning, however. The success of the PSBM will depend on the level of sophistication DoD possesses in four key areas: **leadership, structure, management, and culture**. The focus and combination of these areas become the basis for a successful business model execution that drives organizational outcomes. A description of each area and a brief summary of future opportunities are provided in the following paragraphs. Chapters 5 and 6 address these opportunities in more detail.

### *Leadership*

A good strategy allows leaders to control through a cloud of uncertainty and provides subordinates authority and resources to respond collaboratively with speed and precision. It begins with a core strategic vision (CSV) that unquestionably communicates the leader's intent and the value proposition associated with these objectives. The PSAT SSG has established the

life cycle product support vision and guiding principles to provide that vision and direction, but, as this effort matures, leadership must continue their persistence in making this change.

Leadership gets people and organizations to align in support of accomplishing a common task (Warfighter support) by making it a priority. That takes more than saying "this is a top priority," however. Although the vision is clear, more effort on actionable and quantifiable performance targets that include ***enterprise performance, not just program performance***, will be required. As information becomes available, more guidance will be required for making choices or strategic trades when there are competing priorities for the same resources. But more importantly, leadership must ensure that the visibility, tools, and other resources to accomplish the effort are commensurate with their expectations.

#### *Structure*

The PSBM provides a joint structure to facilitate DoD alignment, appropriate resource allocation, and accelerated information flows. However, as this effort evolves, there must be more detailed effort in articulating structures for processes, governance, cost, and communication.

#### *Management*

Management methods align execution and provide a closed-loop system that motivates high performance. In establishing the strategy for PSBM, there are three key management areas: portfolio, workforce, and performance management.

- **Portfolio management** aligns enterprise resources (money, assets, and people) with priorities to improve the potential of achieving the CSV
- **Workforce and infrastructure management** includes human capital strategy (assuring the right labor mix of quantity, skills, and location) as well as the facility and asset ownership, control, and utilization decisions
- **Performance management** is the monitoring and controlling of behavior to ensure alignment with the CSV

#### *Culture*

Webster's dictionary defines culture as "the set of shared attitudes, values, goals, and practices that characterizes an institution or organization." Culture is the pattern of behavioral norms that members believe will make them successful. This includes values, expectations, and work practices. The tenets for the PSBM address these very well, but the challenge remains to institutionalize this model and inculcate the culture throughout the Department. This requires development and integration into official Department policy guidance, into acquisition reform thrusts, and incorporation in the Quadrennial Defense Review (QDR) and future strategic reviews. There will also be a significant effort to develop and roll out a training and educational plan for the PSBM.

### Conclusion

The PSBM directly supports the product support vision and guiding principles by providing a structure and decision matrix that focuses on weapon system outcomes, controlling product life

cycle cost, and optimally aligning DoD and commercial industry capabilities. It provides options that enable this (industry/government) balanced perspective and outlines desired product support roles and responsibilities, integration responsibility, the recommended contracting approach, and necessary incentives across government and industry. This model not only provides the framework for individual programs and their subsystems, but also creates a foundation for standardizing financial and operational data elements that enable cross-program capability, product support enterprise benchmarking, information sharing, and improved decision making across DoD.

The model provides a strong foundation on which to dramatically improve product support. The successful implantation of the model will require tangible actions, as indicated in the box below:

***Recommendation Key Tasks***

1. Revise DoD and military Service product support policy to incorporate the PSBM
2. Prepare a PSBM guidebook for program managers
3. Formalize the logistics and product support cost structure to be used as the baseline to assess future improvement

Finally, strong and committed leadership is necessary. Every DoD transformation effort faces the inherent obstacles of institutional resistance to change and the intrinsic deliberate pace of bureaucracy. Effecting transformation in this environment—even when widely acknowledged as vitally needed—requires visionary and determined leadership. They must accept the reality that given the current environment and national priorities, there is no alternative but to transform product support. Only this level of commitment will be able to overcome the tendency to devolve into tedious dialogues and debates, and keep the focus on the major reform objectives. The PSAT SSG has established the life cycle product support vision and guiding principles, but effecting the transformation must involve the collective support of OSD, Military Departments, DoD Agencies, and industry as well.

# Chapter 4: Strategies for Implementing the Life Cycle Product Support Business Model

The product support business model (PSBM) introduced in Chapter 3 captures the overarching strategy for life cycle product support. This chapter introduces two underlying strategic recommendations for the product support business model: the industrial integration strategy and the supply chain operational strategy.

These recommendations enable the PSBM strategy and begin to describe the framework needed to perpetuate product support improvement. The industrial integration strategy speaks to the opportunity for synergy from a more collaborative organic and commercial industrial base; the supply chain operational strategy provides tools for a common language and measures to benchmark and improve the performance and progress of that relationship.

## Industrial Integration Strategy

***Recommendation:*** Align and expand the collaboration between government and industry that produces best value partnering practices.

Interdependence between the government and industry is a fact of product support.

> *The US defense industry is certainly not without its flaws and limitations. Yet, in comparison with other countries', it is certainly the most impressive and enviable. The US industrial base has been a source of American strategic advantage in the past, and there is every reason to think that, with enlightened policies and behavior on the part of the federal government, it can continue to be a source of enduring advantage in the future…to ensure the United States has the strong, innovative defense industry the nation will certainly require in the decades ahead, the federal government will need to develop more consistent, thoughtful, long-term, and effective policies toward the defense-industrial base.*
>
> *—Barry Watts: The US Defense Industrial Base: Past, Present and Future, 2008*

It is undeniable that effective product support requires contribution from both the public and private sectors. As established in the previous chapter, the government is fully responsible and accountable for product support delivered to the Warfighter, and often, product support must be performed by the government, particularly by the military in forward deployed environments. Further, there is a huge, long-standing investment in organic support capabilities, particularly in DoD inventory control, distribution, and maintenance depots, that should be effectively and efficiently employed. Certainly, the organic base does much, though cannot do all of DoD's product support work. American industry—or more poetically in the words of President Franklin Roosevelt, the "great arsenal of democracy"—is a source of innovation and productive capacity for the military force. More than 60 years after World War II, when the standing commercial industry still seen today formed, DoD has yet to fully leverage the knowledge, skills, and capabilities of the defense industrial base through a considered and deliberate integration strategy.

Emergent product support best practices have been defined and refined at the maintenance depots over the course of the past decade, providing cogent lessons on how to approach industrial integration. These best practices are not specific to depot-level maintenance. They span across all components of the supply chain and can be generalized across the breadth of product support activities and the full life cycle of weapon systems commonly referred to as "beyond maintenance." Viewed as "Through Life Support" in the United Kingdom, these best practices describe an approach to extend the notion of successful partnership beyond depot-level maintenance activities and catalyze innovation in both government and industry. This expands the scope of partnering from a narrow, statute defined maintenance-based approach to a broader, fully-integrated approach across the product support spectrum.

Much remains to be done. While progress has been made in terms of moving away from "arms length" contracting, much room remains to truly achieve "Partnering for Outcomes." Future product support is not all public or all private; it is instead based on relationships that fully use the expertise and capabilities of both parties.

Create a partnership approach, which is less "adversarial" in style, based on a mutual understanding of where the motivations and interests of each party lie, acknowledging and managing the areas of divergence and tension, and a willingness to share information in a spirit of openness and transparency at all levels.

Congress and various administrations have debated for many years to determine who should perform depot work and where it should be performed. Central to this debate is the interplay between various forms of private sector and organic facility collaborations in depot maintenance and Title 10 provisions that:

1. Limit private sector workloads to 50 percent of available funding in a fiscal year,
2. Require the government to maintain certain core capabilities in military depots, and
3. Require public-private competitions for certain workloads.

The public-private partnership concept for improving government operations provides a cooperative atmosphere for resolving this debate and highlights the path to developing a framework for implementing a forward-looking industrial integration strategy.

Public-private partnerships[23] are a specific form of industrial integration and are proven to enhance product support. Documented results include better parts availability, reduced parts cost, reduced repair time, reduced backorders, and reduced depot support costs. Public-private partnerships have stimulated private sector investment in facilities and equipment, improved facilities utilization, reduced costs of ownership, and promoted more efficient business processes. Public-private partnerships capitalize on what each partner does best, sharing best practices between industry and government, opening the door to innovation in the organic base.

This values-based partnership approach to product support across the life cycle is proven.

*While the success factors at the heart of partnership serve to provide an objective framework, successful working relationships are characterized by soft factors such as teamwork, trust and honesty. When the Department and its industry partners display these*

[23] Title 10 Section 2474 defines these as "public-private cooperative arrangements" to achieve multiple objectives, including "foster cooperation between the armed forces and private industry."

*behaviors they are more likely to develop a common understanding of the task, the progress being made and give early warning of problems.* [24]

This approach to innovation lies in the business environment itself—a partnership approach which is less "adversarial" in style, based on a mutual understanding of where the motivations and interests of each party lie, acknowledging and managing the areas of divergence and tension, and a willingness to share information in a spirit of openness and transparency at all levels. Implementation of this next-generation industrial integration strategy requires work captured in three specific key tasks.

### *Recommendation Key Tasks*

1. Support the capture of a broader set of baseline data, including types, size, structure, and characteristics of partnering agreements
2. Establish policy and training to expand partnering "beyond maintenance," drive standardization across Services, and promote proactive establishment of single-source repair capability
3. Propose modifications to Title 10 to enable maximum implementation of industrial integration

**1. Support the capture of a broader set of baseline data, including types, size, structure, and characteristics of partnering agreements.**

The Department needs to establish a more comprehensive partnering data baseline to assess decisions and make better ones in the future. The emphasis should be on Major Defense Acquisition Programs (MDAPs). For each partnership, facts like type of partnership, correlation with success characteristics, size of workload, timeframe, performance incentives, award fees, termination rationale, and gain sharing should all be captured. Program structures should be correlated with key success factors.

While debate still continues on the proper business structure for partnering, whether it is direct sale, teaming, or work share, there are best practices that transcend the various flavors of partnering and are generally common across the portfolio. Figure 14 details the success factors of good partnering. First documented by the Government Accountability Office (GAO) in 2003, the PSAT used this same framework in 2009 to test the contemporary understanding of "good partnering."

With a rich foundation of over 350 partnerships to date, capturing and characterizing partnering best practices common across the portfolio is possible. A 2007 DoD report, "Public-Private Partnerships for Depot-Level Maintenance through the End of Fiscal Year 2006" details the cumulative impact of the 348 partnerships executed as of that time:

- Creating or sustaining almost 5,000 government jobs
- $3.7 billion in total revenue
- $50.2 million of private sector investment
- Improved product support, performance, and business practices; updated technology and cost avoidance; and increased facility utilization

[24] The United Kingdom's National Audit Office – Driving the successful delivery of major projects, HC30 Session 2005–06.

Input on these partnerships was sought from both industry and government sources:

- Depot Commanders at the annual "Peer-to-Peer" (P2P) meetings
- Industry representatives from the Aerospace Industries Association (AIA)
- Industry representatives from the National Defense Industries Association (NDIA)
- A "Tiger Team" working on the Joint Strike Fighter (JSF), including both industry and government members

***Figure 14: High Correlation among Factors Cited as Success Factors in Partnerships***

| Success Characteristic | GAO | P2P | NDIA | AIA | JSF |
|---|---|---|---|---|---|
| Long-term relationship and commitment | ● | ● | | ● | ● |
| Shared partnership vision and objectives | ● | ● | ● | ● | ● |
| The right metrics and incentives | ● | ○ | ○ | ● | ● |
| Early acquisition community involvement | ● | ○ | | | ● |
| Complementary skills and abilities | ● | ● | ● | ● | ● |
| Senior-level advocacy and support | ● | ● | | ○ | ● |
| Sound business case analysis | ● | ● | ○ | ● | ● |
| Mutual trust and shared risk | ● | ● | | ○ | ● |
| Flexibility to change partnership scope | ● | ● | ● | | ● |
| Balanced workload | ● | ○ | ● | | ● |
| Independent review and oversight | ● | ○ | ○ | | ● |
| Enforce partnership decisions and requirements | ● | ○ | ○ | ○ | ● |
| Full coordination with all stakeholders | ● | ● | ● | ● | ● |
| Clearly documented objectives | ● | ● | ● | ● | ● |
| Process integration across the partnership | | ● | ● | ● | ● |
| Core and DSOR early, 50/50 respected throughout | | ● | ○ | | ● |
| Tech data available as required | | ● | ● | | ● |
| Investment in continuous improvement by all | | | ● | | ● |
| Transparency; full and open communication | | ● | ● | ● | ● |

● Explicitly cited in source documents ○ Partially or implicitly cited in source documents Blank = Not cited in source documents

The 2003 GAO findings have stood the test of time and are as valid now as they were six years ago. These data, taken as a set, provide a rich description of the success characteristics of good partnerships and are equally valid within and beyond maintenance.

There are a myriad of interesting findings embedded in the consolidated description of success characteristics of good partnership. These are particularly compelling in considering the implementation of "partnership" in the context of a product support business model:

- *Long-term committed relationships*, executed with flexibility and integrated across organizational boundaries, with complementary skill sets and abilities, are both essential and possible.

- *Shared partnership vision and objectives with the right metrics and incentives* drive alignment and are especially effective when supported by a clear delineation of complementary roles and responsibilities.
- *Full coordination with all stakeholders*, supported by transparency, open communication, and the flexibility to change partnership scope, is an essential ingredient to success.
- *Clearly documented objectives* support alignment and fuel the success of the partnership. This can be achieved through incentives that drive desired outcomes and are supported by sound economic analysis.

**2. Establish policy and training to expand partnering "beyond maintenance," drive standardization across Services, and promote proactive establishment of single-source repair capability.**

To meet its goals, DoD should create a partnership guidebook using data collected for partnering across the sustainment competencies. It must incorporate the best practice success characteristics developed at the depot, arsenal, and ammunition plant level as the benchmark, and collaborate with Defense Acquisition University (DAU) to update training curriculum to expand the concept of partnership "beyond maintenance." Further, policy should be established to promote the use of supply chain partnering early in program life cycle planning to leverage government and industry capabilities and establish a single authoritative source of depot repair for the programs. This source of repair is then expanded only as throughput requirements dictate. There is nothing that restricts the application of partnership to the maintenance arena. Even if specific statutory authority is not provided for a given situation, government has the inherent authority to conduct its business in a reasonable manner. Making use of government resources in collaboration with industry, with work share agreements as an example of using both public and private sector facilities and employees to perform work for the public sector, to leverage expertise and optimize product support is reasonable.

Even if specific statutory authority is not provided for a given situation, government has the inherent authority to conduct its business in a reasonable manner.

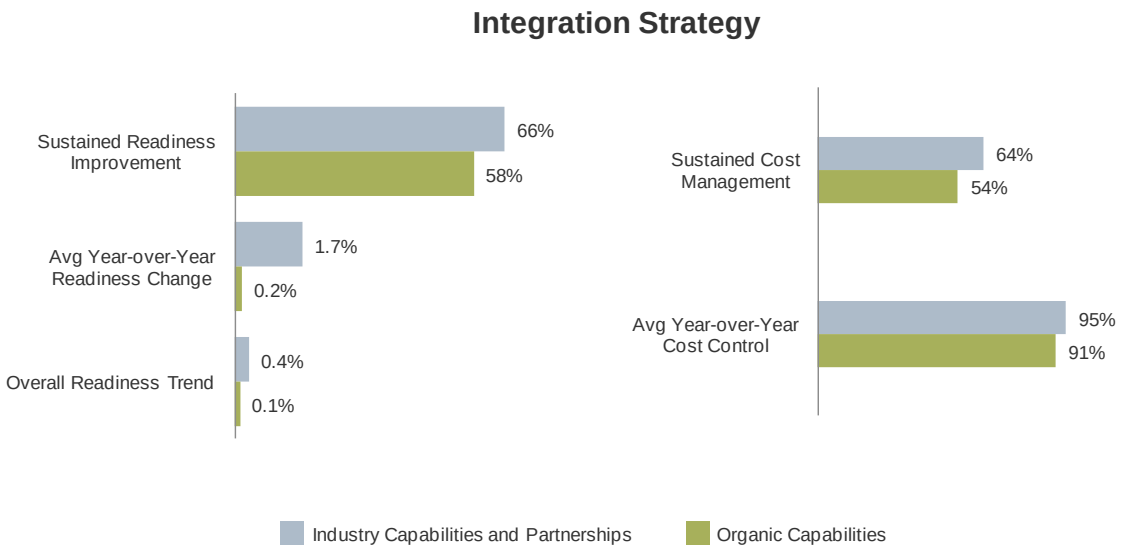
In a recent study,[25] OSD reported that 99 of the 348 depot maintenance partnerships demonstrate "Explicit Product Support Performance Improvement." Analysis of the narratives associated with these improvements indicates these improvements were related to "supply support (parts and material), tech data, information systems, test, training, technical assistance, transportation, packaging, engineering analysis, inventory management, quality support, logistical services, materiel movement, etc." While these areas also enable maintenance, this report uses them as examples of product support "beyond maintenance."

Analysis of Service-provided weapon system data shows strategies involving partnering with industry yield an 8 percent higher sustained readiness than pure organic approaches. They also yield a 10 percent higher sustained cost management, as shown in Figure 15. Appendix A

[25] Office of the Secretary of Defense, "Public-Private Partnerships for Depot-Level Maintenance through the End of Fiscal Year 2006," dated July 2007. Prepared for the Deputy Under Secretary of Defense (Logistics and Materiel Readiness) by the Joint Depot Maintenance Activities Group.

provides deeper exploration of, and analytical details behind, the quantified benefits. However, the pursuit of industrial integration on a larger scale presents real and fundamental challenges to the Department of Defense.

***Figure 15: Industry Partnerships Yield Better Readiness Improvement and Cost Management[26]***




The strategy will not deliver unless the whole of the community, including both government and industry, is able to make the necessary shifts in behaviors, organizations, and business processes. Historically, private industry has been more nimble in the development and implementation of new best practices; via partnering, private industry has been instrumental in directly assisting the incorporation of these best practices into public facilities. DoD has seen the impact that this has had at the depots, with examples such as Lean Six Sigma impact at Letterkenny (LEAD) via the HMMWW Recap partnership between DLA, LEAD, and AM General; GE-driven continuous improvement activities at Jacksonville; and the emergent approaches embedded in the Joint Strike Fighter.

Adoption of partnership approaches on a broader scope necessarily provides impetus to the cross-fertilization of best practices between industry and the organic base. At the same time, there exists considerable core competency in the government community, particularly in human capital and infrastructure, which means that there should be cross-fertilization from the organic base to industry.

DoD therefore must establish policy and training to expand partnering "beyond maintenance," driving standardization across the Services and promoting proactive establishment of single source of repair capability early in a program's life cycle.

[26] See Appendix A for analysis details.

3. **Propose modifications to Title 10 to enable maximum implementation of industrial integration.**

DoD must recognize that different objective drivers apply to industry and the government. The prime drivers for the government are inherently those of mission accomplishment and compliance, while industry is accountable to a bottom line. This does not mean that goals cannot be aligned. As has been seen at the depots, a common ground can be found, and the inherent tensions associated with these divergent drivers can drive more optimal outcomes.

A rethinking of the nature of partnership includes statutory requirements and issues which may impede effective and affordable implementation of a Warfighter-based product support strategy. A more consistent approach to financial rules and incentives, putting organic and commercial organizations on equal footing, will inevitably lead to more predictable results. Revised or new statutory requirements should do three things:

1. Propose a strategy for enabling, requiring, and monitoring the ability of the Department of Defense supply chain offices and industrial activities to produce performance-driven outcomes and meet materiel readiness goals with respect to availability, reliability, total ownership cost, and repair cycle time.
2. Enable industry investment in DoD's industrial and other product support activities by submitting a legislative change to modify the government ownership requirement of depot and other support equipment and facilities used in support of core capabilities.
3. Establish reporting constructs to stimulate financial and cost reporting equivalency (i.e., comparable) between industry and the government and require cost transparency to the greatest extent possible while respecting the need to protect competition sensitive information.

As with competition, partnership can eliminate unnecessarily duplicative capabilities and increase efficiency. This recommendation provides the organic base with the same opportunities available to the industry.

## Supply Chain Operational Strategy

***Recommendation:*** Connect platform product support strategies to enterprise supply chain approaches that produce best value across the DoD components.

There are three phases in the DoD product life cycle: Requirements, Acquisition, and Sustainment. All are supported by the Planning, Programming, Budgeting, and Execution (PPBE) process. When looking for immediate O&S cost saving opportunities, sustainment is a logical target since it is a current year expense which encompasses 60 to 75 percent of the life cycle support costs. The majority of that cost is enveloped in its supply chain. This supply chain is a network of elaborate, complex, and integrated segments where any element, down to the basic raw material, impacts materiel readiness.

Warfighters depend on all repair parts, raw materials, equipment, consumable supplies, warehouses, transportation assets, maintenance/manufacturing facilities, and service elements of this supply chain to carry out their mission. DoD supply chain practitioners understand this and

often make herculean efforts to execute their perceived role in the supply system. Without an end-to-end perspective, they cannot tell whether their efforts are contributing to making the entire product support supply chain more effective. They should know how they impact Order Fulfillment Cycle Time (OFCT), Perfect Order Fulfillment (POF), and Supply Chain Management Costs (SCMC) because these metrics (for speed, reliability, cost, and efficiency) have a direct impact on readiness.

From a program's perspective, the supply chain has a direct impact on the total cost and readiness of a weapon system. The better a Program Manager (PM) can understand and influence the supply chain, the more likely he is to achieve the weapon system performance objectives. Managing and balancing the supply chain requires the PM to know how the supply chain elements (plan, source, make/maintain, deliver and return) interact and then to make informed trades between these elements. A supply chain reference model provides product support managers a tool to consistently measure supply chain attributes and performance, conduct root cause analysis, and benchmark against other systems to determine realistic program expectations and potential best practices. Once the weapon system's required outcomes are established, the product support manager can use the reference model's tiered metrics structure to determine the weapon system's supply chain requirements.

The supply chain operational strategy must be more than just architecture. The idea that it must enable an "enterprise" approach to product support is recognized in the PSAT guiding principle, "*Enterprise Means Enterprise*." In meeting this guiding principle, DoD must:

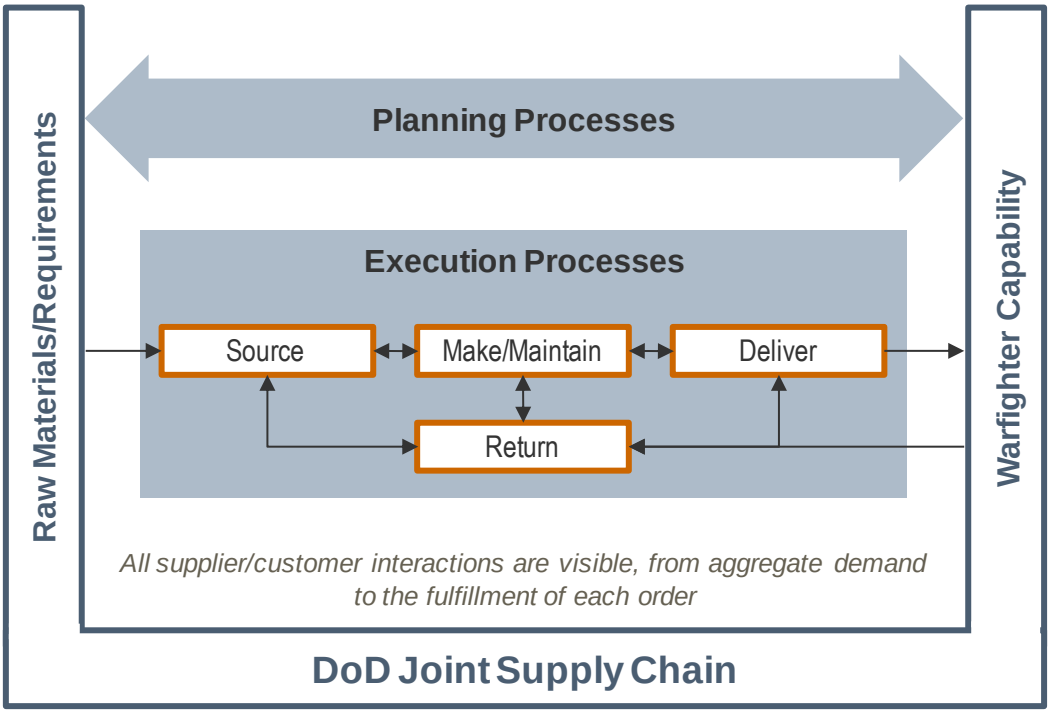
- Capture every opportunity for joint economy and reduce unnecessary redundancy,
- Build the capability to make good enterprise decisions, and
- Enforce consistency in product support processes and infrastructure.

Currently, there is no single entity that has responsibility for or can effectively manage the complex end-to-end DoD supply chain.

These implementation guidelines form the basis for the supply chain operational strategy. This strategy provides the framework and standards of performance to drive joint and cross-program efficiencies. Data collection and analysis continually reinforces ongoing decision making. The supply chain operational strategy also provides the best practices, metrics, processes, and enablers to support enterprise stakeholders in day-to-day sustainment execution.

DoD Supply Chain Management's linkage to product support is its coordination of the government and commercial processes (plan, source, make/maintain, deliver, and return) and resources required to ensure that Warfighters' equipment are ready to accomplish the mission. A depiction of this is shown in Figure 16.

*Figure 16: The Supply Chain Architecture Provides the Structure for Converting Material into Warfighter-Defined Outcomes*




Defense supply chain management poses significant challenges. If focused on an individual weapon system, the supply networks would likely follow the product support programs they service and be largely structured around weapon system platforms. Funding for supply chain resources is often budgeted and managed within platforms, with limited visibility across programs and across Services to drive efficiencies that would result from leveraging a common supply base, transportation and distribution infrastructure, and maintenance infrastructure. While some improvements have been made by DLA and TRANSCOM in aligning the supply base and the defense distribution and transportation networks, there is still significant work to be done to reduce overall system inventory and optimize the time it takes for system sustainers to get the parts they need. The defense supply chain must align common processes, materials, and resources to deliver better performance at lower cost. Global sourcing and distribution must be considered to meet today's supply chain challenges. Commercial best-in-class providers will provide benchmarks that help shape the DoD standards for speed, reliability, and efficiency of all supply chain processes. Metrics measure how DoD is performing and provide the basis for targeting continued improvements over time. Linking resources, material, information, and processes to deliver the outcomes the Warfighter needs requires development, implementation, and use of an operational strategy or configuration of supply chain elements.

The supply chain operational strategy outlined in this chapter addresses critical challenges identified in the PSAT discovery process and weapon systems analysis. DoD has efforts underway to improve the supply chain processes, roles, and responsibilities. But there is still much to be done to align incentives, metrics, and processes and enforce consequences for poor

performance. In addition, IT tools do not support integrated supply chain decision making, a result of poor visibility across programs and Services.

The supply chain operational strategy provides the frameworks, "go-to" resources, and tools to enable implementation of supply chain best practices across DoD and Industry that are aligned for effective product support.

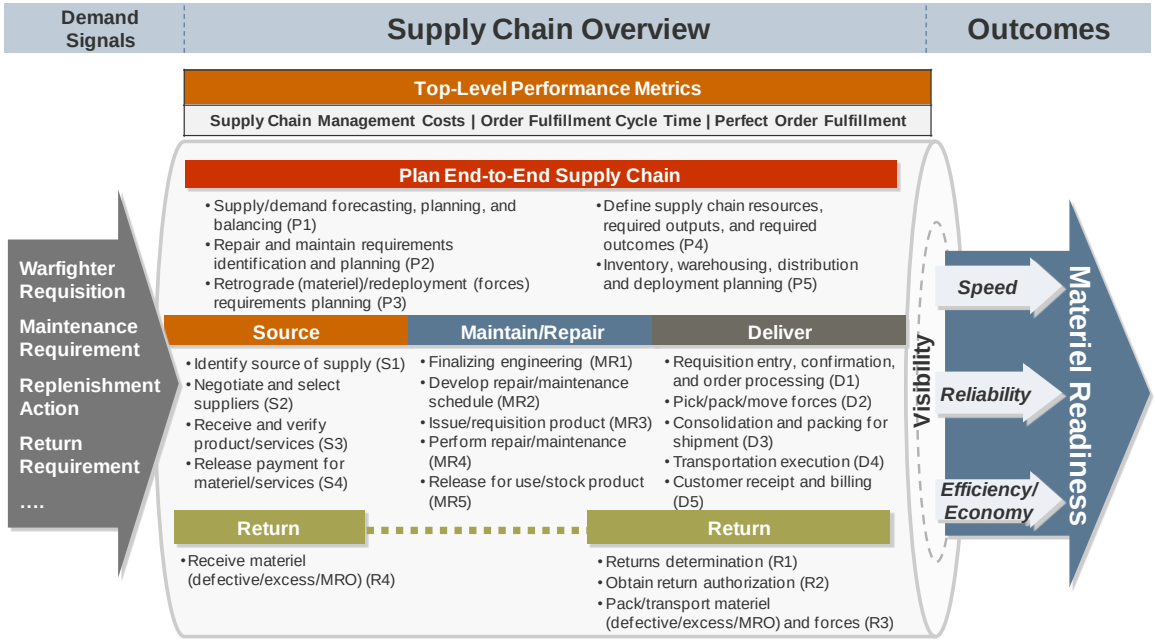
### *Recommendation Key Tasks*

1. Institutionalize the joint supply chain architecture across Department, Service, and private industry suppliers
2. Establish a common enterprise information architecture and visibility (e-hub) to provide consistency and synchronization services between supply chain participants
3. Develop and manage a Supply Chain Management Body of Knowledge (SCM BOK)

**1. Institutionalize the joint supply chain architecture across Department, Service, and private industry suppliers.**

Implementation of this recommendation is accomplished through rollout and application of the ADUSD-SCI Joint Supply Chain Architecture (JSCA) reference model. The JSCA provides the structure for product support managers to understand and influence the supply chain elements that impact product support. Figure 17 shows a more detailed view of the JSCA model, which focuses on three top level performance metrics: supply chain management costs, order fulfillment cycle time, and perfect order fulfillment to improve materiel readiness through efficiency, speed, and reliability.

***Figure 17: The Joint Supply Chain Architecture (JSCA) Provides a Hierarchy of Processes Tied to Common High-Level Metrics***



Derived from the Supply-Chain Operations Reference-model® (SCOR®), the standard for commercial supply chain management, JSCA reflects the unique attributes of the defense supply chain, serving as the basis for identifying performance and configuration opportunities for maintaining and improving materiel readiness and supply chain efficiency. JSCA looks across organizational and funding boundaries for the purposes of improving the DoD's supply chain effectiveness and efficiency by employing an enterprise wide, end-to-end perspective to achieve or improve materiel readiness at best value. JSCA is not a software application; it is a framework for implementation and is focused on driving process improvements, enabling informed supply chain decision making, and facilitating communication and unity of effort across the DoD supply chain enterprise. JSCA is a fairly new initiative that will evolve and be enhanced over time.

The details of JSCA specifically identify best practices, metrics, and enablers for key stakeholder in the DoD Supply Chain. Fundamentally important to these stakeholders is the balance between supply and demand and the quality of the collaborative relationships required to achieve this balance. JSCA provides the common language and metrics, such as Demand Plan Accuracy (DPA), that allow the measurement of these collaborative relationships' outcomes. It also provides the foundation for performance benchmarks across Service and industry joint supply chains to include benchmarking against other weapon systems. This allows identification of intra-DOD best practices, and provides a framework for exploring and evaluating supply chain configuration options.

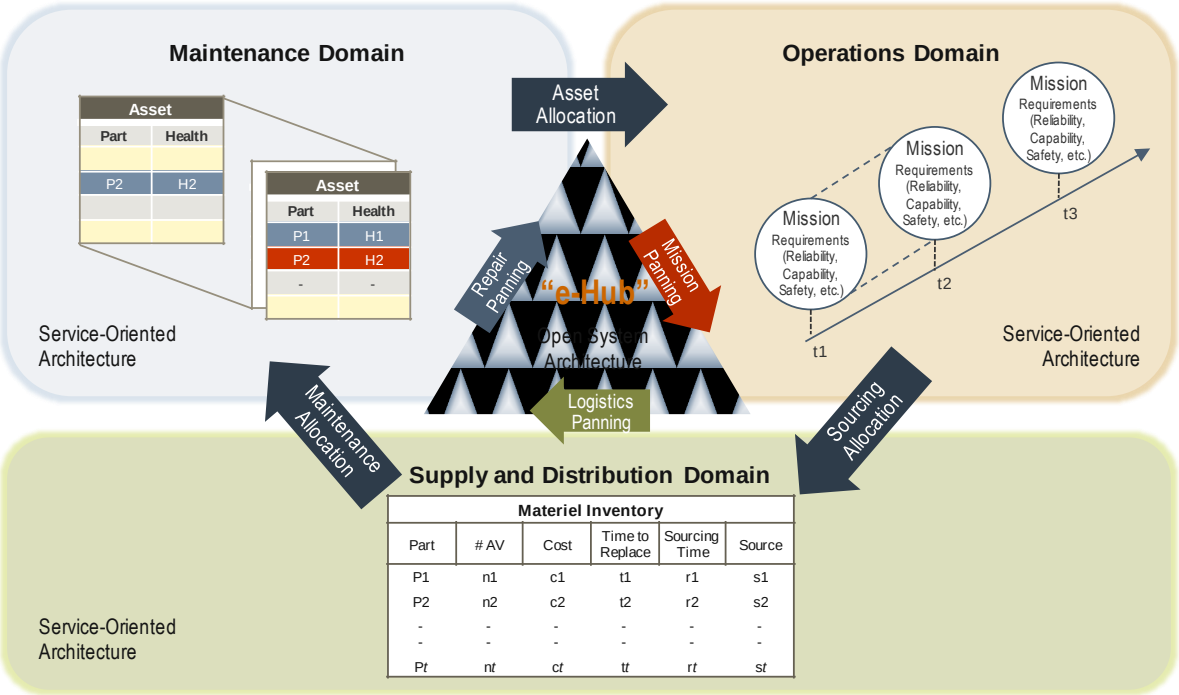
**2. Establish a common enterprise information architecture and visibility (e-hub) to provide consistency and synchronization services between supply chain participants.**

A viable common enterprise information architecture that enables the seamless, instantaneous flow of information across the Services and their suppliers is needed for end-to-end supply chain from retail through wholesale; from the Warfighter to the supplier's supplier. This architecture supports JSCA management via an open system architecture that captures and associates partnerships. Examples are already being used for real-time collaborative integrated supply chain applications for line-side replenishment, outbound logistics, and constraint management. These examples have demonstrated benefits, such as:

- Only one interface to manage
- Standardized information exchange methods
- Reduced Service-specific ERP integration issues
- Increased security (Information Assurance)
- Supports Service Oriented Architectures (SOAs)
- Scalability, upgradability, and interchangeability

Currently, Service-specific Enterprise Resource Planning (ERP) systems discretely manage supply chain applications such as repair line replenishment, outbound logistics, and depot management. The next step is to combine the Services' and Agencies' supply chain management tools through an open system architecture, an example of which is shown in Figure 18, to create DoD-spanning supply chain visibility, improve cross-Service supply chain usage, and promote enterprise-wide supply chain optimization.

*Figure 18: The "e-Hub" Combines Supply Chain Information from the Services and Supporting Agencies to Create a Common Operating Picture*




## 3. Develop and manage a Supply Chain Management Body of Knowledge (SCM BOK).

Structured around the JSCA, the SCM body of knowledge is used to help standardize and improve training and skill development for supply chain competency and best practices as they relate to product support.

The SCM BOK will be process based, meaning it describes work as being accomplished by processes. This approach is consistent with other management standards such as ISO 9000, and the DoD Extension to the Project Management Body of Knowledge (PMBOK® Guide), all of which describe processes in terms of:

- Inputs (documents, plans, designs, etc.)
- Tools and Techniques (mechanisms applied to inputs)
- Outputs (documents, products, etc.)

The SCM BOK should be a detailed repository institutionalizing the five basic process groups that are typical of almost all supply chains, government, and commercial, as referenced in *DoD 4140.1-R, the DoD Supply Chain Materiel Management Regulation.*

1. Plan
2. Source
3. Make/Maintain
4. Deliver
5. Return

A Government/Industry not-for-profit association (AIA, NDIA, SCC, etc.) is the best way forward in developing a DoD SCM BOK. The primary objective is to serve as a forum to exchange views and information directly related to supply chain planning, sourcing, manufacturing and maintaining, delivering, and returning processes.

## Conclusion

The industrial base has and will continue to provide innovation, infrastructure, and skills for a modern, ready defense force. The PSBM seeks to capitalize on this tremendous asset through more industrial collaboration and partnering between organic and commercial entities…moving more to a single defense industrial base. This requires more information sharing, common focus and consistent metrics to measure progress and make informed decisions. The supply chain operational strategy provides that standard lexicon, benchmarking and decision metrics and a proposed information sharing construct needed to manage this integrated industrial base and the broader end-to-end DoD supply chain.

## Chapter 5: Recommended Processes and Enablers for Implementing the Product Support Business Model

The product support business model provides the vision of and framework to achieve evolved and improved sustainment. A better integrated industrial base helps establish the partnerships needed to use the best capabilities of government and commercial industries to build that framework into a vibrant product support infrastructure. Further, the supply chain operational strategy explains and provides tools to manage how government and commercial industry will work together through sharing common language, metrics, and measurement tools. Chapter 5 expounds on the strategies outlined in Chapters 3 and 4. It provides operational recommendations that make these strategies tangible.

Despite the fact that the vast majority of life cycle costs—at least 70%—are expended after systems have been acquired, sustainment-related inputs have historically been underrepresented during weapon systems investment decision deliberations. Today's weapon systems are fielded in an environment of significant and growing uncertainty. We face a complex and evolving threat, and the Secretary of Defense has made a call to balance conventional modernization programs with capabilities needed for today's conflicts.[27] Training and sustainment strategies, the main elements of O&S costs, continue to evolve. Given these uncertainties, it is extremely difficult to forecast O&S costs with confidence. Exacerbating these problems, the Departmen has not established a process for systematically tracking and assessing O&S costs.

Despite the fact that the vast majority of life cycle costs—at least 70%—are expended after systems have been acquired, sustainment-related inputs have historically been underrepresented during weapon systems investment decision deliberations.

The challenge facing DoD in transforming weapon system life cycle product support can be described like a puzzle, where each piece must fit with not just one but several adjoining pieces, and the final puzzle solution (i.e., the big picture) is not apparent until all of the pieces are in place. The study team found deficiencies in the major corner piece of this puzzle, *sustainment governance*—the consistent and cohesive oversight across the management, policies, processes, and decision-making for sustainment to ensure that sustainment information is a critical component of weapon system acquisition and throughout the life cycle. Governing and managing the weapon system life cycle is further challenged by inconsistent collection and use of sustainment *metrics*. Of primary importance in today's economic climate is better collection and management of *O&S costs*, which are rising at the macroscopic level. Without the ability to make consistent and fair cost comparisons across programs within the same Service or across Services, DoD will never achieve the ability to identify, manage, and mitigate major cost drivers within programs and within portfolios of capabilities. Compounding these challenges are documented historical difficulties in selecting and executing appropriate *analytical tools* to derive meaning from these cost and performance metrics and facilitate product support strategy decisions. The final piece of this puzzle is the critical need to ensure that the DoD acquisition and logistics work force has the requisite skills for executing outcome-based support, driving the need for a more integrated *human capital* strategy.

[27] Gates, Robert M., "A Balanced Strategy, Reprogramming the Pentagon for a New Age." *Foreign Affairs*, January/February 2009 Edition.

## Governance

***Recommendation:*** Improve weapon system governance so sustainment factors are better considered early and consistently across a weapon system life cycle.

Every programmatic decision made during the entire life cycle of a DoD system should be made with the knowledge of how that decision will impact the life cycle sustainment of that system. While that objective sounds relatively easy to accomplish, decades of experience show that it is actually extremely difficult. There are two primary reasons for this difficulty: lack of perceived relative importance of long-term costs—in other words, current cost impacts drive today's decisions that tomorrow's leaders will be left to address—and lack of valid, measurable sustainment metrics, especially cost projections.

Historically, a "field-and-forget syndrome" has dominated acquisition decision making. DoD's planning, programming, budgeting, and execution system (PPBES) has not effectively focused on the materiel readiness, reliability, maintainability, and life cycle cost of a weapon system. Dismissal of these key factors has long-lasting consequences for systems that operate 30–50 years before their retirement. Yet this is what generally occurs since future year defense plans (FYDPs) are limited to relatively near-term budget considerations and Program Managers are more focused on the immediate issues occurring on their watch.

Furthermore, there are limited formal consideration points for sustainment information and data into acquisition decision-making processes and forums. As sustainment information evolves, there is no formal structure to update this information for ease of decision-making or historical comparison during milestone reviews. Relevant insertion points—from Materiel Development Decision (MDD) to initial operational test and evaluation (IOT&E)—currently lack the relevant data necessary to understand costs and other sustainment factors associated with supporting the weapon systems long term.

Improving sustainment governance to make information more visible and decision-making more disciplined throughout the weapon systems life cycle will result in improved product support outcomes. Understanding and managing toward a consistent set of metrics, particularly ownership costs drivers, will allow decision makers to make better informed investment decisions across the portfolio of weapon systems. So, how can life cycle sustainment considerations be a viable factor in the acquisition decisions made during the design, development, and production of DoD's weapon systems? The following recommendation key tasks help to address this challenge.

### *Recommendation Key Tasks*

1. Strengthen guidance and policy so that sustainment factors are sufficiently addressed and governed at key life cycle management decision points (MDD, milestones, etc.)
2. Issue DoD policy to require the Components to conduct an independent logistics assessment (ILA) prior to Milestone B, Milestone C, and FRP, and provide the ILA report to DUSD (L&MR) 30 days before the milestone decision
3. Create a post-IOC review led by DUSD(L&MR) and the respective Service(s) responsible for life cycle management

1. **Strengthen guidance and policy so that sustainment factors are sufficiently addressed and governed at key life cycle management decision points (MDD, milestones, etc.).**

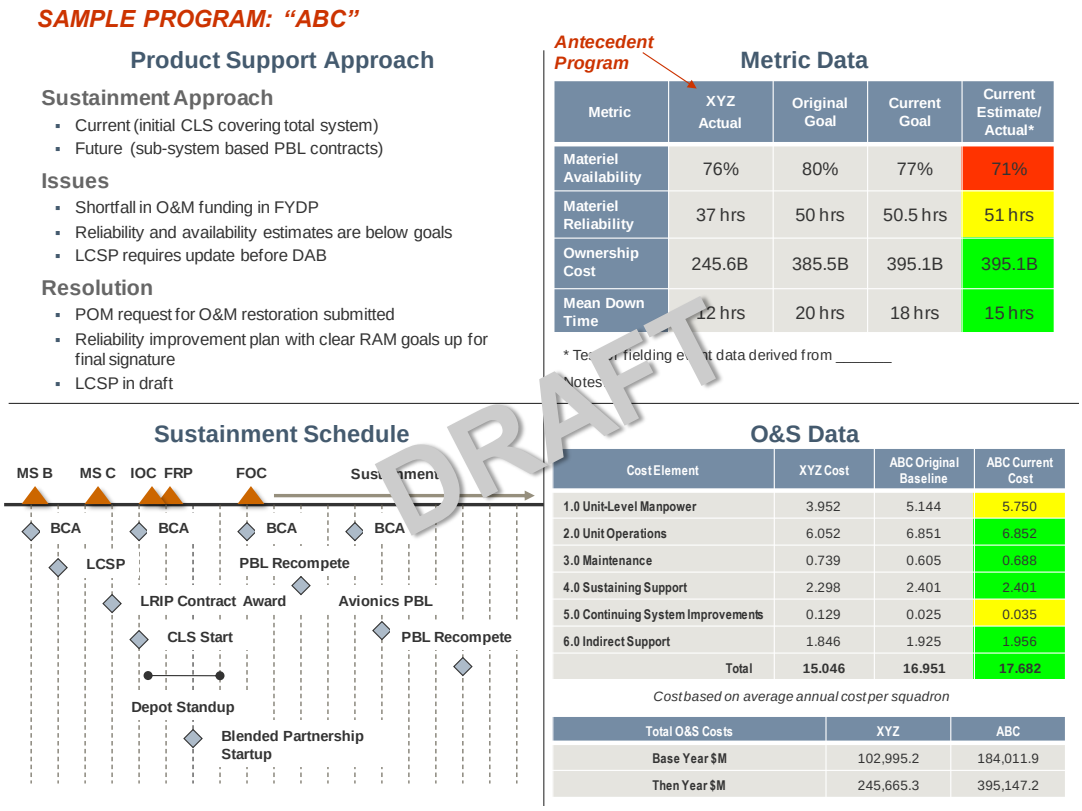
DoD stakeholders have invested significant resources in updating guidance and policy as they relate to the acquisition process and life cycle sustainment. Specifically, OSD has published two sustainment-centric memorandums[28] and an updated instruction.[29] The updated Defense Acquisition Guidebook (DAG) describes the "what" and the "how" of being able to meet the instruction's requirements. Guidance is also being developed for the Analysis of Alternatives (AoA) event, the Technology Development (TD) phase, and Portfolio Systems Acquisition.

Moreover, the Services have demonstrated progress with sustainment governance. For example, the Department of Navy has instituted ACAT "Gate Reviews" for major acquisition milestone decision points and beyond. Included in those reviews is a post-IOC "Sustainment" Gate to assess Probabilities of Program Health per measured initial systems performance. Sustainment Gates raise and resolve operational command sustainment issues in terms of readiness, KPP/KSA metric performance, Life Cycle Sustainment Plan (LCSP) execution, logistics interoperability and investment opportunities, and supportability effectiveness and ownership cost affordability to date.

A new tool is also recommended for use throughout the weapon system life cycle. Much like the "Spruill Chart" depicts a program's funding status, the "Sustainment Chart" ensures sustainment information relative to strategy, metrics, and cost is addressed at milestones and reviews. The Sustainment Chart (Figure 19) is intended as a key decision-making tool because it readily identifies a weapon system's product support business model and captures its operating and support costs and operational metrics data.

[28] USD (AT&L) memo dated 31 July 09, *Implementing a Life Cycle Management Framework*; DUSD (AT&L) memo dated 10 March 07, *Life Cycle Sustainment Outcome Metrics*.
[29] DoDI 5000.02 dated 08 December 08.

*Figure 19: The Sustainment Chart*




Even though sustainment policy and guidance are readily available and Services and stakeholders, by varying degrees, are working to address and follow them in their acquisition processes, policy and guidance are still not uniformly executed or enforced. Given the lack of readily available data, this is not surprising. Each life cycle management decision point needs specific, accurate, and timely information with sufficient breadth and fidelity to adhere to current policy and guidance. Lacking specificity, data analysis is left to interpretation. Accordingly, this recommendation key task will:

1. Determine the information currently required in guidance
2. Identify the actual information needs for sound governance at each of the critical life cycle management decision points
3. Recommend the minimum set of data/actions required for decision makers to make sound life cycle product support decisions

**2. Issue DoD policy to require the Components to conduct an independent logistics assessment (ILA) prior to Milestone B, Milestone C, and FRP, and provide the ILA report to DUSD (L&MR) 30 days before the milestone decision.**

The Services routinely conduct ILAs as a standard, though not standardized, business process. ILAs are a compilation of information that the Services recognize as important to their life cycle product support governance. It is also important in OSD product support governance. This recommendation builds on the Services' efforts and recognizes the value they potentially add to DoD-wide product support decision-making processes by requiring the Services to conduct ILAs based on their existing ILA templates on (at least) all major defense acquisition programs

(MDAPs), with other programs strongly encouraged. Moreover, this recommendation enhances existing ILA templates by requiring critical information identified in the previous task to be included in all ILAs as a minimum OSD requirement. Finally, it requires the Services to provide the DUSD (L&MR) their completed ILA with sufficient time before each listed decision point to ensure the DUSD (L&MR) can provide an informed and relevant recommendation for milestone assessments and other key decision reviews. Reciprocally, the Office of the DUSD (L&MR) can provide ILA best practice summaries back to the Services to improve corporate DoD sustainment planning.

**3. Create a post-IOC review led by DUSD(L&MR) and the respective Service(s) responsible for life cycle management.**

There is blurred delineation between acquisition and sustainment in the weapon system life cycle. A new post-IOC review can represent the key transition point between the acquisition and sustainment phases of the weapon system life cycle. A post-IOC review with distinct entry and exit requirements[30] marks the passage of a system funded and supported with acquisition processes and dollars to the responsibility of the Service's life cycle command. During the post-IOC review, the system program is formally reviewed, along with its list of known product support issues and corresponding solution recommendations. This review also provides the first post-IOC opportunity for OSD to commit resources to assisting the Service life cycle command in addressing outstanding sustainment issues. Areas to be addressed in a post-IOC review should include:

- Assessment of weapon system performance against its operational and sustainment requirements, particularly sustainment key performance parameters and key system attributes
- Performance against Service unique metrics, such as contractual or performance-based agreement requirements
- Results of Service-independent logistics assessments and business case analyses
- Recommended system improvements that support improved capability or sustainment and Service metrics
- Planned evolution of sustainment strategies

Downstream (post-IOC) reviews can provide improved corporate accountability for long-term operational performance and also inform the planning and decision making for key product support factors, such as availability, reliability, and life cycle cost for future programs. A formal post-IOC review is warranted to both assess operational performance and put back-pressure on existing acquisition reviews to be more disciplined in their attention to down-stream consequences.

[30] Requirements will be developed when implementing this recommendation key task.

## Metrics

***Recommendation:*** Develop an overarching Departmental sustainment metrics and management strategy for life cycle product support that strengthens formal data collection and analysis capabilities, while providing insight and learning to support life cycle planning and operational management.

This recommendation strengthens and operationalizes the overarching formal metrics strategy for all MDAPs laid out in the 31 July 2008 (AT&L) memorandum, called *Implementing a Life Cycle Management Framework*, and encourages the Services to apply it to all non-MDAPs. In turn, weapon system life cycle management is made more effective and efficient by institutionalizing how metrics are used in the strategic management of the weapon system life cycle. To accomplish this, the metrics recommendation will:

- Align metrics collection and usage with desired sustainment outcomes
- Codify the use of these metrics, including the specific IT tools that rely on these metrics to aid management decision making
- Standardize metrics collection and use processes
- Automate business rules used to filter and process data into information for management decisions

This recommendation and its tasks are critical because relevant metrics have been used inconsistently to manage weapon system cost and performance over the weapon system life cycle. This has directly led to unpredictable cost and performance variance at each stage of the life cycle, leading to program cancellations and difficulty managing weapon systems over their life cycles, as demonstrated by:

- The restructuring of the Joint Air-to-Surface Standoff Missile (JASSM) due to systemic reliability issues and subsequent cost growth
- Cancellation of Extended Range Munition (ERM) due to repeated reliability failures

These examples represent billions of potentially wasted tax dollars. Had they been spent in an acquisition process that fostered more life cycle management insight and control, that money could have been spent toward greater capabilities and better financial stewardship.

This recommendation ensures that present and future platforms are managed to assure availability to the Warfighter and responsible managing of tax dollars.

### *Recommendation Key Tasks*

DoD should execute these four tasks to implement the recommendation:

1. Use existing DoD sustainment metrics required by JCIDS and OSD policy to establish and measure progress toward hitting realistic operational performance requirements throughout the weapon system life cycle
2. Use metrics as triggers to conduct further investigation and analysis into drivers of those metrics to influence Reliability, Availability, and Maintainability (RAM)
3. Revise the Ownership Cost KSA to be full O&S cost
4. Investigate the potential of legacy program reporting of the sustainment metrics

**1. Use existing DoD sustainment metrics required by JCIDS and OSD policy to establish and measure progress toward hitting realistic operational performance requirements throughout the weapon system life cycle.**

This task builds on ongoing efforts within the Services and OSD, capitalizing on investments already made in Service-Oriented Architecture (SOA) development, the Defense Acquisition Management Information Retrieval (DAMIR) system, and the Service Automated Information Systems (AIS): Army Information Management (AIM), Dashboard—Navy and System Metrics and Reporting Tool (SMART)—AF. Each AIS reports into DAMIR estimates against established goals for all MDAPs using as required metrics: Availability, Materiel Reliability, Ownership Cost, and the currently optional metric, Mean Down Time (MDT). Availability is a required KPP for all new MDAPs, along with Materiel Reliability and Ownership Cost as KSAs. Including MDT with the KPP/KSAs provides the complete sustainment picture for a program. Therefore, making the MDT a required metric submission within DAMIR is encouraged. Using these existing metrics avoids the confusion of institutionalizing additional top-tiered and important-but-lower-tiered metrics across DoD that the Services already use as needed in their program offices. Instead, it enables consistent and mapped information channels for the Services to communicate with OSD, with other Service Components, and internally.

This task also requires the automated quantitative data collection and reporting initiatives already under way at OSD to include the creation of automated information channels to capture the underlying processes that led to the quantitative data collected by these systems. It requires the creation of a process for Program Managers, combatant commanders, and OSD to establish and agree on life cycle sustainment goals that are updated throughout the weapon system life cycle. Finally, it requires the establishment of a quantitative and qualitative baseline for all post-IOC MDAPs using the lower-tiered metrics that drive Reliability, Availability, and Maintainability.

**2. Use metrics as triggers to conduct further investigation and analysis into drivers of those metrics to influence Reliability, Availability, and Maintainability (RAM).**

In support of the RAM initiatives outlined in the 21 July 2008 USD (AT&L) memorandum *Reliability, Availability, and Maintainability Policy* and Congressional language in the 2009 Weapon System Acquisition Reform Act, the Department should strengthen its emphasis on addressing RAM early and throughout a system's life cycle. Using metrics as triggers institutionalizes the best practice of using data to control the process of life cycle product support

governance at all levels, from the strategic to the tactical. It ties with the governance recommendation presented earlier by allowing automated comparison of actual performance against agreed-on reliability, availability, maintainability, and cost goals. This includes both the actual performance of fielded systems and the predicted performance through modeling and simulation (M&S) of systems in development and helps inform ongoing governance within the Services and OSD.

This task operationalizes Task 1's metrics through the use of enterprise dashboards that help drive decision makers to good choices. Moreover, it requires the creation of standard operating procedures for those immediate and initial analyses that should be completed whenever agreed-on trigger points are reached.

**3. Revise the Ownership Cost Key System Attribute (KSA) to be full O&S cost.**

Revise the Ownership Cost KSA to be full operating and support cost. This builds on the Sustainment Key Performance Parameter (KPP) and its mandatory supporting KSA of Ownership Cost defined in the CJCS Joint Capabilities Integration and Development System (JCIDS) Manual dated 31 July 2009. This document specifies ownership cost be comprised of several elements developed under the Cost Analysis Improvement Group (CAIG), now Cost Assessment and Program Evaluation (CAPE). This cost should further account for the cost of all direct and indirect labor associated with a system and should consider clarifying the definition of "fully burdened cost of fuel" to include the cost of managing fuel supply lines and the risk of disruption of those supply lines, as discussed in the JCIDS selectively applied Energy Efficiency KPP. Finally, the standard estimated weapon system lifespan of 20 to 25 years should be reevaluated to determine if longer estimated life spans are warranted.

This change will provide OSD and the Services with a more comprehensive picture of the actual cost to operate and support systems and will allow improved decision making across the system life cycle when evaluating alternatives during development.

**4. Investigate the potential of legacy program reporting of the sustainment metrics.**

DAMIR should be viewed as the primary tool to display metrics data for fielded systems as it currently is the warehouse for active MDAP sustainment reporting. In addition, legacy programs already house fields under the inactive programs function in DAMIR. The Services have implemented collection and reporting of the sustainment metrics on select programs in accordance with the 31 July 2008 USD (AT&L) memorandum *Implementing a Life Cycle Management Framework* and the subsequent 11 December 2008, ARA/L&MR memorandum *Implementation of Life Cycle Sustainment Outcome Metrics Data Reporting*. As directed in the 31 July 2008 AT&L LCM memorandum, legacy programs that have ceased SAR and DAES reporting should be reviewed for sustainment metrics reporting. Applying metrics reporting across the entire weapon system life cycle will enable true sustainment management. Fielded systems have access to existing metrics databases, which can be leveraged to supply sustainment metrics data.

Implementation of this task requires a mix of investigation and analysis to understand existing capabilities of legacy programs to collect and report data; what changes are feasible from a financial and execution standpoint; development of a plan to fund, pilot, and then roll out data collection and analysis processes for candidate systems; and the execution of that plan.

## O&S Cost Management

***Recommendation:*** Make life cycle affordability a core business process for all communities and stakeholders involved in system acquisition and sustainment.

Making life cycle affordability or resource allocation a core process enables several key transformations. Namely, it:

- Moves beyond the traditional approach of estimating costs, focusing on what the Department can afford over the life cycle to achieve required capabilities
- Shifts from the current DoD focus on the acquisition element of the life cycle cost (LCC) and limited emphasis on the O&S costs of individual programs to increased emphasis on ownership costs for the entire enterprise
- Provides flexibility in achieving holistically affordable system operational effectiveness without prescribing specific initiatives or provider biases

This recommendation and its resultant transformations address two fundamental issues with how DoD manages O&S costs:

1. DoD does not take an integrated view of O&S costs across portfolios (e.g., tactical air warfare, heavy lift, etc.) or across the enterprise—either Service or DoD wide. DoD tends to look at O&S costs from an individual vertical weapon systems perspective, and not across all weapon systems to see the overall Total Obligation Authority (TOA) impact.
2. DoD does not take a long-term view when budgeting for the major supply chain elements (e.g., the horizontal perspective including maintenance, transportation, spares procurement, etc.). Supply chain budgets only consider a small portion[31] of the costs incurred by all the programs within the DoD weapon system inventory, many of which operate for more than the 20 years planned for during acquisition.

These transformations are critical since O&S cost comprises 60 to 75 percent of the life cycle cost, which is growing as systems operate longer than planned. Considering that DoD spends at least $132 billion on product support costs across the DoD enterprise each year, even a small O&S cost improvement results in significant savings to the Department. Moreover, despite the five base realignment and closure (BRAC) rounds and numerous initiatives, such as the Defense Management Review Decisions (DMRD) in the 1990s, Reduction in Total Ownership Cost (RTOC), etc., DoD has historically experienced over 2 percent O&M growth and 1 percent manpower cost growth over and above inflation each year. This recommendation addresses this growing gap.

[31] O&M budgets cover one year, MILCON three years, and overall programming only looks out six years into the future. Consequently, the long-term cost impact to DoD is not taken into account, especially when fielding new systems, which often are more costly than the systems they are replacing.

### *Recommendation Key Tasks*

The major tasks to implement this recommendation build off recent DoD and Congressional initiatives, including the Weapon Systems Acquisition Reform Act of 2009. These tasks are to:

1. Establish an O&S affordability requirement, including linking O&S budgets to readiness
2. Develop and implement processes and procedures with key communities, engaging them in the affordability process
3. Increase visibility of O&S costs and their drivers across the supply chain

**1. Establish an O&S affordability requirement, including linking O&S budgets to readiness.**

Readiness and affordability must jointly drive product support strategies across weapon systems life cycles and across capability portfolios. A key element of establishing an O&S cost requirement based on what the Service can afford, backed by even stronger governance processes, is to use existing Service pilot initiatives to link resources to readiness, building off the Service lessons learned from using the life cycle sustainment cost. This task expands upon the concept across the enterprise by including appropriate metrics to help ensure the supply chain is aligned in how cost relates to performance to achieve the outcome needed by the Warfighter without suboptimizing supply chain segments.

**2. Develop and implement processes and procedures with key communities, engaging them in the affordability process.**

This task creates buy-in from all primary DoD stakeholders. It requires that:

- Combat and materiel developers must use realistic estimates of O&S costs in Analyses of Alternatives (AoAs) and other trade studies that support milestone decision review LCC considerations be given serious consideration during design tradeoffs within the programs, as well as in OSD and the Service's acquisition milestone decisions
- The financial and program management community apply a balanced set of outcome, quality, responsiveness, and cost metrics to each element of the supply chain

**3. Increase visibility of O&S costs and their drivers across the supply chain.**

This task builds off lessons learned from several recent initiatives and recognizes insights from the ongoing GAO review of O&S cost and the Cost Assessment and Program Evaluation (CAPE) study in response to the Weapons System Acquisition Reform Act of 2009. It is structured to gain better insight of actual O&S costs and key drivers. Accomplishing these efforts helps with future projections and validates that actual costs are in line with the estimates on which decisions are based. Determining the extent to which O&S-related accounts need to be parsed at the weapon system level, or the extent that any required budget element changes, are early activities within this task. That analysis will then be used to determine the investment required to ensure information systems are capable of disaggregating the O&M accounts.

## Analytical Tools

***Recommendation:*** Clarify and codify policies and procedures pertaining to the use of analytical tools in the life cycle product support decision-making process.

The use of the business case analysis (BCA) process to make life cycle product support decisions, mandated by policy since 2004, has been plagued with problems of inaccuracy, inconsistent application across the Services and weapon systems, and a general failure to achieve the purpose for which it was intended. The shortcomings of the BCA process include inaccurate data, inappropriate deadlines for BCA completion, and the perception that there is a one-size-fits-all BCA process, which, if followed, is both expensive and requires excessive manpower to execute. It is no surprise that decision makers cannot be sure if the BCA outputs they are using to support their decisions have been determined using a consistent or sound methodology.

Current BCAs focus mainly on finite cost comparisons. This is inconsistent with DoD policy directing a life cycle total ownership cost perspective that provides superior "best value" decision making. They ignore the fact that there are also statutory (Title 10) and policy factors that dictate workload allocation regardless of best value, or that some product support strategies promote long-term investment in cost reduction and improved performance over the life cycle but may be marginally more expensive in the short term. And, finally, current DoD policy mandates the use of BCAs only for PBL product support strategies. This policy is both incongruous and inappropriately exclusive because all product support strategy decisions should be subject to an analytic process.

The analytic process by which product support decisions are made should vary by data elements, timing within the life cycle, and the unique characteristics of the objective system and its operational environment. New acquisition and development program analysis should be markedly different from that accomplished for out-of-production legacy systems. Conditions early in the life cycle are marked by immature data and the absence of a ready organic product support infrastructure; later in the life cycle, costs are more mature and organic support infrastructures have been established. Accordingly, there is no single-point-in-time life cycle product support decision, but rather an evolving, iterative process that addresses the changing data, environment, and operational outcomes of each system. The analytical tools must align with the phase of a weapon system life cycle to be effective. Since the maturity of weapon system data and information evolves as the weapon system moves through the life cycle management process, the product support analysis should become a living document that is updated at regular intervals based on current data. Thus, it becomes a decision-making enabler rather than a static snapshot for one-time use.

An effective analysis balances both cost and readiness. For BCAs to improve in effectiveness as a decision-making tool, it is necessary to address, clarify, and codify the larger group of "analytical tools" by which the analysis should be conducted. DoD cannot "fix the BCA process" alone without addressing the core systemic issue that traditional BCAs are just one of many analytical tools in the toolbox, and that each tool should be examined for its applicability within the life cycle of a program.

Implementing the analytical tools recommendation helps decision makers compare weapon systems programs that have followed a similar methodology to arrive at business analysis

outputs. Using standardized analytical tools leads to standardized data collection expectations and standardized analytical outputs across Services, resulting in greater opportunities for joint approaches. Ultimately, joint approaches maximize supply chain and product support channels and reduce overall risk and costs for programs.

Finally, the benefit of expanding the analytical tools examination beyond BCAs provides DoD a greater opportunity to satisfy BCA root-cause problems found by GAO auditors. A consistent analytical tools approach will allow DoD to provide consistent responses to internal reviews and external audits.

### *Recommendation Key Tasks*

After addressing the larger group of analytical tools, DoD should narrow its scope to provide specific improvements for the use of BCAs to support decision making. DoD should implement the following three tasks to realize this objective:

1. Publish a product support analysis "toolbox" handbook
2. Provide guidance on conduct of the product support analysis process and establish policy on the use of analytical tools to support decision making
3. Develop updated training on sustainment analysis to include BCAs

Rather than prescribe a single inflexible analysis process, these three tasks are intended to provide decision makers with a better understanding of not only what types of analysis are appropriate for various programs at various periods within their life cycle, but also what information they should be requesting and receiving to make better analytical decisions. These tasks are meant to shift DoD's perspective from one that is BCA-focused to one that includes a variety of options to aid in their decision making. Each task is discussed in more detail below.

**1. Publish a product support analysis "toolbox" handbook.**

OSD should establish and facilitate a team of representatives (e.g., Services, DLA, industry, Joint Staff, modeling and simulation (M&S), test and evaluation, DAU, etc.) to collect known available analytical tools to understand what is currently available within the community that supports decision making. This should ensure consistency in processes and analytical outcomes among community stakeholders across the life cycle management framework.

This team should identify gaps between tools that are available, identify tools that should be available, and propose new analytical tools or models to fill gaps.

The representative team will define and publish the toolbox handbook. The toolbox handbook will include the analytical tools that are available to decision makers, how and when different analytical tools are used, and what necessary inputs and outputs are associated with each tool.

**2. Provide guidance on conduct of the product support analysis process and establish policy on the use of analytical tools to support decision making.**

OSD will provide guidance in DODI 5000.02 and the Defense Acquisition Guidebook (DAG) regarding implementation of the product support toolbox analysis handbook.

This guidance will define and address the core elements, factors, criteria, and analytic tools consistent with analysis across the range of DoD systems pertinent to (at minimum) the following characteristics:

- Type of program (new acquisition/development or legacy program)
- Maturity of the program (various stages of the life cycle from early [e.g., Milestone A] through later [e.g., IOC])
- Specific criteria to be included, including quantitative, qualitative, and non-cost boundary conditions (Title 10, Service Policy, other)
- Level of objective system: system, subsystem, or component
- Recommended iterative review cycles for updating the analysis
- The appropriate level (depth) of analysis, recognizing that early program analysis may be less comprehensive and have short-term time value, whereas later program analysis will be more comprehensive and have longer-term applicability

Until formal policy and guidance (i.e., DODI 5000.02 and the DAG) can be revised, a policy memorandum should be issued by OSD AT&L and cosigned by Cost Assessment and Program Evaluation (CAPE) directing that all programs use analytical tools to assist in determining a weapon system's support strategy and to provide rationale for contract arrangements. The policy should be broad enough to allow the Services to incorporate the guidance they already have; it should encourage all communities—e.g., Joint Staff, M&S, testing, CAPE—to work together; and it should amend the AoA to include analytical alternatives more attentive to product support.

### 3. Develop updated training on sustainment analysis to include BCAs.

Lastly, DAU should leverage the toolbox handbook to develop and offer additional training courses and CLMs on analytical tools for use in sustainment analysis, including BCAs. DAU's approach should cover the characteristics of each tool and how and when it can be applied during a program's life cycle.

Furthermore, recognizing that BCAs are presently conducted using a team of representatives from different organizations and with differing expertise, DAU should work with Service SMEs to develop and schedule BCA-specific team (vice general) training to coincide with the kickoff of a product support analysis team. Additional and more detailed training on product support analysis should be given to cover the use of analytical tools and processes such as core logistics analysis and source of repair analysis that may provide feeder data into the objective system analysis.

## Human Capital

***Recommendation:*** Integrate product support competencies across the logistics and acquisition workforce domains to institutionalize successful traits of an outcome-based culture.

Product support human capital derives primarily from two sources: the defense logistics workforce and the defense acquisition workforce.[32] Neither workforce domain demonstrates widespread product support competency across all career fields in the respective domains. Yet, the ability to achieve improved product support outcomes consistent with the recommendations of this report depends on a broader constituency capable of effective product support management. The encouraging news is that the logistics and defense acquisition workforce are the beneficiaries of effective and exemplary human capital strategic planning efforts over the past several years.

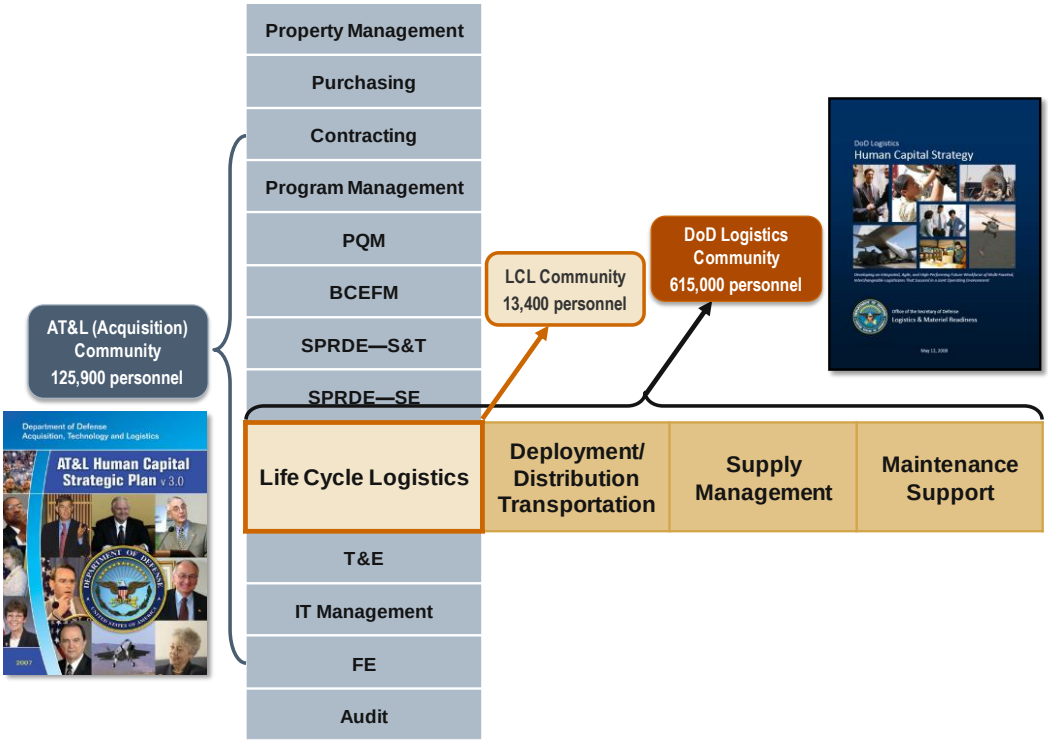
The DoD Logistics functional community is comprised of more than 615,000 active duty military and civilian personnel[33] who fall into one of four logistics workforce categories. Of these four logistics workforce categories, "Life Cycle Logistics" is most closely associated with product support competencies. The Life Cycle Logistics area is comprised of approximately 13,400 personnel who make up 2 percent of the total logistics workforce.

The life cycle logistics workforce stands at the nexus between the 615,000-member logistics workforce and the 125,900-member defense acquisition workforce. As shown in Figure 20, besides the life cycle logistics career field, there are other career fields in the acquisition workforce that must demonstrate product support competencies, specifically the program management, systems engineering, production/quality management, and to some degree the contracting career field.

The seven Life Cycle Logistics competency areas identified in the May 2008 DoD Logistics Human Capital Strategy (HCS) are generally descriptive of the product support competency set and therefore must be fully incorporated into defense acquisition workforce training. Key focus areas for competency incorporation, enhancement, and improvement include life cycle sustainment planning; life cycle cost management; PBL strategy implementation; supportability analysis; reliability, availability, and maintainability (RAM) analysis; configuration management; and technical data management/product data management.

[32] The DAWIA-coded workforce.
[33] Augmented by over 200,000 Guard/Reserve personnel.

*Figure 20: Product Support Lives in All Neighborhoods of the Acquisition and Logistics Communities*




### *Recommendation Key Tasks*

DoD should continue implementation of initiatives embodied in the AT&L Human Capital Strategic Plan and the DoD Logistics Human Capital Strategic Plan. Both sets of human capital planning initiatives are integral to continuing a focus on cross-cutting logistics and acquisition workforce-reshaping strategies. Further, to implement the recommendations and initiatives offered by this PSAT report, the following six tasks should be accomplished:

1. Identify new or modified product support competencies and proficiencies driven by proposed PSAT strategy, policy, and process changes
2. Incorporate new or modified product support competencies into DoD and industry logistics and acquisition workforce career field training, recruitment, and retention strategies
3. Identify potential assimilation requirements for supply management, maintenance support, and distribution/transportation workforce members into the acquisition life cycle logistics career field
4. Capitalize on Section 852 Defense Acquisition Workforce authorities to grow and develop the future product support workforce
5. Expand integrated life cycle management training at DoD universities, public universities and institutions, and corporate universities
6. Update key DoD guidebooks and handbooks to facilitate defense logistics and acquisition workforce professional development and workplace application

1. **Identify new or modified product support competencies and proficiencies driven by proposed PSAT strategy, policy, and process changes.**

The DoD Senior Functional Leader for Life Cycle Logistics should take the lead on this action. Using the existing competency sets identified in current acquisition career fields per the AT&L competency studies performed by the Center for Naval Analysis (CNA) and logistics career fields per the May 2008 DoD Logistics Human Capital Strategy as a baseline,[34] a "gap analysis" should be conducted to identify what strategic, functional, policy, processes, and related training/learning assets change in the future as a result of PSAT recommendations, thereby requiring new competency sets to be incorporated into training curriculum and other workforce management activities.

2. **Incorporate new or modified product support competencies into DoD and industry logistics and acquisition workforce career field training, recruitment, and retention strategies.**

Extending from Task 1, the DoD Senior Functional Leader for Life Cycle Logistics should coordinate with other acquisition career fields (particularly program management, systems engineering, and contracting) and logistics workforce categories (particularly supply management and maintenance support) to incorporate new and revised competencies into applicable curriculum and other workforce-management activities. This coordination can be best effected by working through the Defense Acquisition University, the Logistics Functional IPT, the Acquisition Management Functional Group, the Overarching Functional IPT, the DoD Logistics Human Capital Executive Steering Group, and the National Defense Industrial Association.

3. **Identify potential assimilation requirements for supply management, maintenance support, and distribution/transportation workforce members into the acquisition life cycle logistics career field.**

The defense acquisition Life Cycle Logistics workforce has 13,400 members, increasing by 7 percent since 2005 as a result of increasing the designation of positions as acquisition. Increased DoD attention to life cycle management initiatives and the inclusion of product support strengthening would signal that continued growth should be expected in this career field. In FY 10–11, indications are that approximately 3,800 additional Life Cycle Logistics career field personnel will be assimilated into the acquisition workforce by the Defense Components and the Defense Logistics Agency. Government insourcing strategies will likely influence an upward trend in such assimilation as well. This action will be led by the Defense Components, who independently determine which of their workforce positions are identified as part of the acquisition workforce.

4. **Capitalize on Section 852 Defense Acquisition Workforce authorities to grow and develop the future product support workforce.**

In Section 852 of the 2007 National Defense Authorization Act, Congress directed the Secretary of Defense to establish a fund to be known as the Department of Defense Acquisition Workforce

[34] DoD Logistics HCS implementation is awaiting an enterprise tool for capturing and validating competencies and their levels. This enterprise tool will not only capture competency identification and proficiency levels of the current workforce but will also achieve a more accurate baseline of competency sets.

Fund to provide resourcing for the recruitment, training, and retention of DoD acquisition personnel. The purpose of the fund is to ensure that the DoD acquisition workforce has the capacity needed, in both personnel and skills, to properly perform its mission, provide appropriate oversight of contractor performance, and ensure that the Department receives the best value for the expenditure of public resources. DoD should ensure that life cycle management and product support workforce members receive the benefits of the statutory authority. Most of the prerogative for taking advantage of Section 852 opportunities rests with the DoD Components and the Defense Acquisition University in aggressively and expeditiously implementing new course development and updates to incorporate the new DoD logistics competency set into their learning assets.

**5. Expand integrated life cycle management training at DoD universities, public universities and institutions, and corporate universities.**

Life cycle management and product support professional development occur at many sources today including the Defense Acquisition University, military Service Academies, defense institutes, public universities, independent contractor training, and industry corporate universities. All should be the focus for expanded integrated life cycle management training. Such a widely distributed task cannot be well instrumented by a single entity; however, the Life Cycle Logistics Senior Functional Leader and the Defense Acquisition University can be integral in leading the coordination and sharing of competency requirements and existing curriculum products. It is worth investigating the potential of a DoD/industry clearinghouse approach for such curriculum sharing.

**6. Update key DoD guidebooks and handbooks to facilitate defense logistics and acquisition workforce professional development and workplace application.**

Processes and procedures for applying key competencies contained in the DoD Logistics Human Capital Strategy are addressed in a variety of key DoD publications, handbooks, and guidebooks, which require revision. These include:

- Designing and Assessing Supportability in DoD Weapon Systems: A Guide to Increased Reliability and Reduced Logistics Footprint Guidebook (Oct 03)
- Performance Based Logistics: A Program Manager's Product Support Guide (Mar 05)
- Acquisition Logistics Guide (Dec 97)
- MIL-HDBK-61A Configuration Management (Feb 01)
- MIL-HDBK-502 *Acquisition Logistics* (Jan 05)
- MIL-PRF-49506 Logistics Management Information (Jan 05)
- GEIA-STD-007 Logistics Data Product Data (Aug 07)
- GEIA-HDBK-007 Handbook for Logistics Data Product Data (Jun 07)

Human capital management is a vital enabler to all recommendations resulting from this report. The tasks above provide an effective institutionalization of expanded product support competency coverage for the logistics and acquisition workforce in both DoD and industry. This allows the ability to leverage existing structures and innovative opportunities.

# Chapter 6: Life Cycle Product Support Implementation

This chapter provides the operational details of implementing the Product Support Assessment Team (PSAT) recommendations. It starts with an overview of the core change management philosophy used to minimize the transition stress associated with every large-scale change. It continues with a detailed view of the core team that implements the PSAT recommendations, as well as the management structure that ensures this implementation is effective, timely, and aligned with the life cycle product support vision and guiding principles. Finally, it ends with the high-level tasks for each recommendation in a section referred to throughout this chapter as the "Implementation Plan."

## Change Management Philosophy

Planned and effective change management greatly increases the chance of successful change. This change management high-level plan is founded on three bedrock tenets:

1. **Department-wide change requires Department-wide leadership**—Parent organizations must lead implementation of the recommendations detailed in this document to ensure all changes are logically applied, executable, and have the buy-in of those who execute or are affected by them.
2. **What gets measured gets done**—Progress on implementing each recommendation is communicated to the most senior DoD stakeholders on a regular and periodic basis.
3. **Maintain complete transparency and openness**—Successful transformation is paramount; a climate of complete transparency and openness to ideas is maintained to ensure complete visibility into obstacles to implementing these recommendations and receptiveness to the innovative solutions that overcome them.

## Core Team Concept

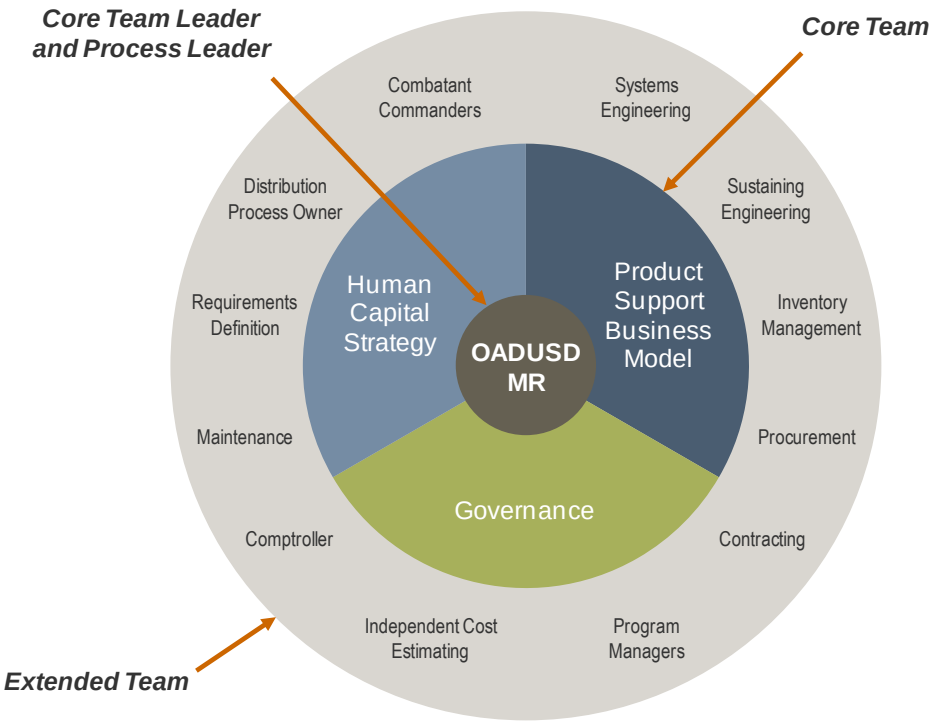
The core team, shown in Figure 21, provides a focused and flexible framework to facilitate successful PSAT recommendation implementation. The core team leader is responsible for the overall management of the team's routine effort and is staffed from the Office of the Assistant Deputy Under Secretary of Defense for Materiel Readiness. Assisting the core team leader is the process leader, who manages day-to-day change management processes, such as tracking progress against the Implementation Plan and helping fix any problems that occur during implementation.

A core team of approximately 15–20 vested stakeholders leads the implementation of PSAT recommendations. This team is composed of OSD staff, members from each Service and DLA, and select Aerospace Industries Association (AIA), National Defense Industrial Association (NDIA), and academia members who (1) have in-depth knowledge of the PSAT recommendations and of the stakeholders these recommendations will impact, and (2) are influential within their respective organizations to drive buy-in and collaboration across the enterprise.

The extended team supports the core team and allows reach back to resources who are involved in the project but do not attend core team meetings. These extended team members typically

have infrequent, but important, impact on the project—data rights, contracts and legal organizations, as well as those who play a supporting role such as engineering or testing. The extended team can also include those who provide strategic or advisory expertise; usually functional experts who lend part of their time to the core team on an as-needed basis. As such, extended team members are identified when resources are constrained or when the core team is unsure of with whom to work.

***Figure 21: The Core Team Concept Identifies High-Level Roles and Responsibilities and Forms the Foundation of Strong Change Management***




The recommendations that the core team implements are broad and require focused effort for success. Accordingly, the core team is divided into three integrated product teams (IPTs), each of which is dedicated to implementing between one and four recommendations. Each IPT is comprised of cross-functional groups of experts who have the skills required to understand and execute the key tasks required by their IPT's recommendations. The core team leader coordinates resource allocation when skills resident in one IPT are needed to help another. These IPTs and the recommendations for which they are responsible follow:

- **IPT #1: Product Support Business Model. This team will:**
  - Formulate guidance and actions necessary to implement the product support business model, ensuring consistent application of the defined PSBM roles, responsibilities, and interrelationships
  - Develop and plan initiatives to align and expand partnerships beyond depot maintenance across the range of product support functions
  - Develop enabling actions and guidance necessary to transition weapon system product support strategies to outcome-based approaches utilizing enterprise-focused supply chain management practices

- **IPT #2: Governance. This team will:**
  - Develop the implementing actions necessary to insert and institutionalize governance of product support across the life cycle
  - Fully implement and institutionalize use of approved sustainment metrics, including cost, as part of product support governance activities, milestones, reviews, and other product support assessment actions necessary to ensure appropriate life cycle management oversight across the entire Defense enterprise
  - Develop recommendations and implementing actions necessary to provide for full visibility, transparency, consistent estimation, and consistent reporting of Operating and Support costs across the Defense enterprise
  - Develop and implement an analytical toolbox-based methodology that will enable the selection of product support options among the business model alternatives over the defense system life cycle
- **IPT #3: Human Capital. This team will:**
  - Develop the recommendations and implementing actions required to define and shape the professional workforce necessary to execute the new product support environment. The objective is a fully integrated acquisition and logistics team that can plan and manage product support while expanding and leveraging broader integration of the public and private sector industrial base

Management oversight for these three teams will be provided by reorganizing the PSAT Senior Steering Group (SSG) into a standing Product Support Executive Council (PSEC). This executive group's efforts should be aligned with other related senior-level groups such as the Maintenance Executive Steering Committee (MESC), the Joint Logistics Board (JLB), and the Weapon Systems Lifecycle Management Group (WSLM).

### Product Support Executive Council

Effective management defines how all parts of the DoD enterprise are involved in designing and deploying the PSAT recommendations, as well as the specific decision rights and contribution expected of each person involved. Even as the core team and core team leader provide management of the strategic, operational, and tactical aspects of implementing the PSAT recommendations, oversight, management, and senior guidance for the implementation of the PSAT recommendations are provided by the PSEC. This body is the evolution of the SSG and is independent of other senior-level groups such as the MESC, the JLB, and the WSLM. The PSEC has a high-level composition, shown in Figure 22, ensuring proper visibility of and support for the implementation of the PSAT recommendations. The exact composition of the PSEC is initially recommended by the PSAT SSG at its final meeting of FY 2009.

*Figure 22: The Product Support Executive Council Representation Ensures Initiatives are Properly Supported and Aligned with DoD Strategy and Life Cycle Product Support Vision and Guiding Principles*

| Product Support Executive Council | | | | | |
|---|---|---|---|---|---|
| ADUSD MR | OSD Staff | Joint Staff | Service Components | Agencies | Industry |

## Management Cadence

The PSEC, core team leader, and core team all work together to provide implementation management. This teamwork requires commonly understood roles, responsibilities, and communication channels, the starting points of which are shown in Figure 23.

Note that the regularly scheduled meetings required by this management cadence ensure that implementation progress is smooth and well known to all stakeholders. Also, any problems with implementing the PSAT recommendations are known and brought to the appropriate decision body before unrecoverable schedule variance occurs.

*Figure 23: Product Support Management Cadence Ensures Implementation Progress Is Tracked and Reported in a Scheduled and Repeatable Manner*

| Role | Responsibilities | Communications Cadence |
|---|---|---|
| **PSEC** | ▪ Ensures alignment of PSAT recommendation implementation with DoD strategies and with the life cycle product support vision and guiding principles<br>▪ Makes executive decisions that impact across service and industry borders | ▪ Meets quarterly |
| **Core Team Leader** | ▪ Leads core team in accomplishing the implementation plan<br>▪ Facilitates operational-level decisions made by the core team<br>▪ Manages all implementation management official communications | ▪ Reports to PSEC quarterly<br>▪ Transmits feedback from the PSEC to the core team as applicable |
| **Core Team** | ▪ Implements PSAT recommendations in accordance with guidance from the PSEC<br>▪ Makes operational- and tactical-level decisions | ▪ Attends meetings monthly or as needed |

## Implementation Plan

This section shows the relationship between the high-level tasks required for full PSAT recommendation implementation via the overarching implementation master schedule, which is part of the implementation plan. Critical to successful implementation is a robust communications strategy and plan; identifying people and organizations that must be communicated with and the appropriate channels in which to conduct this communication, laying

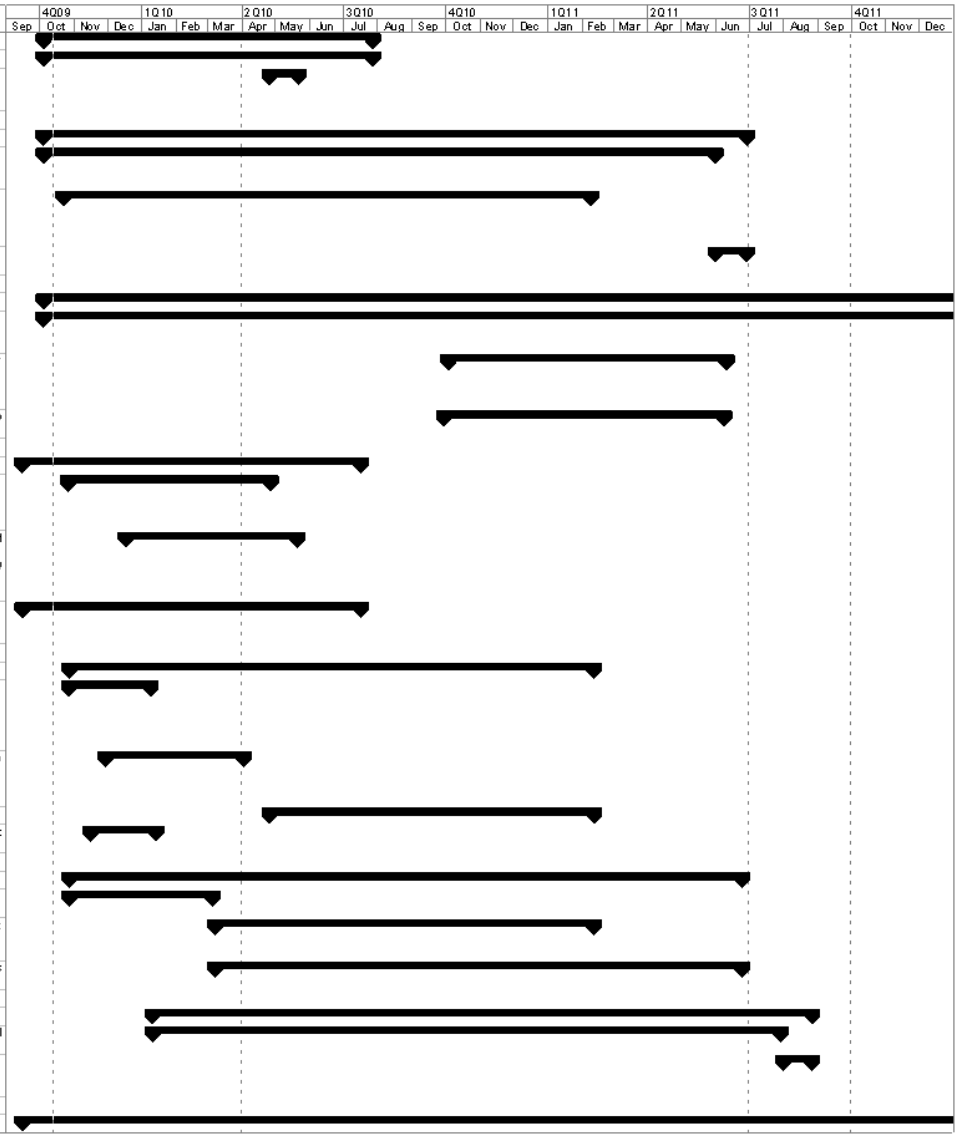
out the communications sequencing plan, and then aligning resources to create and deliver the communications is one of the first tasks the core team leader completes to kick off implementation.

### Implementation Master Schedule

The implementation master schedule provides an executive-level view of how the PSAT recommendations are implemented on a task-by-task basis. Detailed schedules are developed by the core team using the guidance from the initial PSEC meeting, and are agreed on by all stakeholders prior to kicking off their respective recommendations. Generally speaking, though, kickoffs occur according to this schedule.

## *Table 3: Implementation Master Schedule*

| ID | Task Name |
|---|---|
| 163 | Product Support Business Model |
| 164 | Prepare a PSBM guidebook for program managers |
| 189 | Formalize the logistics and product support cost structure to be used as the baseline to assess future improvement |
| 192 | |
| 193 | Industrial Integration |
| 194 | Support the capture of a broader set of baseline data, including types, size, structure, and characteristics of partnering agreements |
| 205 | Establish policy and training to expand partnering "beyond maintenance," drive standardization across Services, and promote proactive establishment of single-source repair capability |
| 215 | Propose modifications to Title 10 to enable maximum implementation of industrial integration |
| 218 | |
| 219 | Supply Chain Operational Strategy |
| 220 | Institutionalize the joint supply chain architecture across Department, Service, and private industry suppliers |
| 226 | Establish a common enterprise information architectur and visibility (e-hub) to provide consistency and synchronization services between supply chain participants |
| 232 | Develop and manage a Supply Chain Management Bo of Knowledge (SCM BOK) |
| 238 | |
| 239 | Governance |
| 240 | Strengthen guidance and policy so that sustainment factors are sufficiently addressed and governed at key life cycle management decision points (MDD, milestones, etc.) |
| 250 | Issue DoD policy to require the Components to conduct an independent logistics assessment (ILA) prior to Milestone B, Milestone C, and FRP, and provide the ILA report to DUSD (L&MR) 30 days before the milestone decision |
| 255 | Create a post-IOC review led by DUSD(L&MR) and the respective Service(s) responsible for life cycle management |
| 262 | |
| 263 | Metrics Strategy |
| 264 | Use existing DoD sustainment metrics required by JCIDS and OSD policy to establish and measure progress toward hitting realistic operational performance requirements throughout the weapon system life cycle |
| 268 | Use metrics as triggers to conduct further investigation and analysis into drivers of those metrics to influence Reliability, Availability, and Maintainability (RAM) |
| 272 | Revise the ownership cost KSA to be full O&S cost |
| 275 | Investigate the potential of legacy program reporting c the sustainment metrics |
| 279 | |
| 280 | O&S Costs |
| 281 | Establish an O&S affordability requirement, including linking O&S budgets to readiness |
| 285 | Develop and implement processes and procedures wit key communities, engaging them in the affordability process |
| 288 | Increase visibility of O&S costs and their drivers across the supply chain |
| 296 | |
| 297 | Analytical Tools |
| 298 | Publish a product support analysis "toolbox" handbool |
| 307 | Provide guidance on conduct of the product support analysis process and establish policy on the use of analytical tools to support decision making |
| 310 | |
| 311 | Human Capital Strategy |



# Chapter 7: Critical Path and Accountability

There is a strong desire among the PSAT participants, and most certainly among the report authors, not to create yet another piece of shelf-ware. To that end, a set of accountabilities must be assigned and a critical path to success must be established. Accountable parties will be those with the most at stake: OSD, the Military Services, the supporting Defense Agencies, and Industrial partners.

In many cases, these reports are more influential than generally credited, but they lack predictive criteria on which one may evaluate their impact. For example, the Product Support Report of 1999 is remembered by few—just the authors and those who recognize that the report did promote some lasting change in Defense product support. Had the 1999 report placed a predictive stake in the ground, we would have had a better means of judging its efficacy. Nonetheless, many initiatives were spawned from this effort. Performance Based Logistics, total life cycle systems management, reduction in total ownership costs, prime vendor arrangements, logistics footprint reduction, weapon system integrated supply chains, and product support integrators are among the initiatives that were catalyzed by that 1999 report.

To what accountability standards can this 2009 report be held as a future touchstone to judge whether its implementation moved ahead the management and science of life cycle support—or fell short?

## Ten Long-Term Accountability Indicators

However desirable in the minds of this report's authors, it is unlikely, nay, unprecedented for a review body to still keep score on this report's recommendations, sub-recommendations, and specific action items in five years. It is likely and indeed a certainty that defense product support will still be in need of continued reform and policy change, and subject to critical resource decisions in five years. So, how will strategy and policy makers know whether the DoD product support process has improved? To answer this, consider that instead of keeping score on how many of the recommendations were fully or partially implemented, borrow a page from the PSAT's outcome-based playbook and recommend that posterity should assess the health and progress of product support and the accountability for this report against the following ten indicators:

1. Future acquisition reform legislative and policy initiatives are life cycle management focused.
2. Program Managers are equipped by life cycle management enablers consistent with PM accountability and responsibility to focus on life cycle cost and readiness.
3. Operating and support costs are visible at the Program, Service, and DoD level and managed in conjunction with acquisition investment costs to make life cycle cost decisions.
4. Sustainment governance influences Defense Acquisition Boards and related weapon system review forums.
5. Product support is more transparent to the Warfighter, but Warfighters are more integral to advocating affordable, readiness-based product support objectives.

6. Supply chains perform at best-in-class levels and are better integrated for weapon system management operational outcomes.
7. An enterprise perspective is not limited to the province of a single military Service, Agency, or information technology backbone.
8. Product support capability assessments are performed at national and global levels, not with a limited or bifurcated view to public versus private capability.
9. Expanded partnering opportunities drive industry to routinely include life cycle cost and performance in the design of weapon systems and enable more robust, integrated industrial base product support.
10. DoD organic organizations are more capable of managing the complex incentives and integration inherent in effective performance-based strategies.

## Accountability and Governance

As noted at the beginning of this report, numerous studies and initiatives have been conducted but product support remains an issue. What makes this report and its recommendations different is that it realizes success does not rest in one activity's efforts, but requires a much larger perspective and enterprise approach. In general, the ownership of PSAT recommendations and assignments is straightforwardly assigned to those organizations identified in the first paragraph of this chapter:

> **OSD** must drive the cultural changes in values, expectations, and work practices through policy changes and budgetary action to resource those policy changes, with oversight and governance to ensure continued progress toward the vision
>
> **Military Services**, who need these changes to execute their Title 10 responsibilities, must be proactive in the implementation of the PSAT direction and interactive with their assistance and support of OSD policy changes
>
> **Industry**, that provides the foundation for design, innovation, and manufacturing, must provide forward-leaning activist support and provide the bridge that links the design chain with the supply chain
>
> **Supporting Defense Agencies,** who are viable supply chain product support providers and have critical Warfighter support capability within the areas of procurement, inventory management, distribution, transportation and disposal operations, must work together with the Military Services and industry for a seamless enterprise approach

Chapter 3 discussed the importance of leadership's core strategic vision and designing the structure to easily and readily facilitate alignment, resource allocation, and accelerated information flows. This overall accountability must rest at one of the highest levels of OSD AT&L. Without becoming bureaucratic and entangling the Services in redundant executive steering committees, it is recommended that the PSAT Senior Steering Group be reshaped to become the PSEC and ensure its membership includes the stakeholders responsible for implementation. The PSEC will be accountable for implementation of this report and annual assessments of its progress. It will be critical to integrate this group's insights into existing similar executive oversight groups such as the Joint Logistics Board, the Maintenance Executive Steering Committee, Supply Chain Integration Executive Groups, and Logistics Human Capital

Executive Steering Groups. There may be a time when the PSAT's executive steering can fully transition and be subsumed within the standing oversight of these or other groups. How these teams are designed and integrated will be a critical piece of the governance recommendation.

OSD will need to hold the torch high and establish and enforce the standards for life cycle management. This will also place the onus on OSD to determine how best to balance competing acquisition vs. logistics priorities. The Military Services (and Defense Agencies) must buy in to the PSAT recommendations and directions, make them their own, and in many cases step out and lead without waiting on OSD impetus. The Services must also embrace that increasingly combat operations are joint in nature—logistics and support operations must follow suit. Industry must continue being a good national security capability partner, promoting innovation, responding to competitive pressures, and flowing down competitively-driven incentives through the supply chain. Together, DoD and industry must recognize there are strengths and weaknesses to both industrial and organic assets, but the synergy together provides tremendous capability, capacity, and technology that must be captured for the good of the Warfighter.

### Critical Path

Many important initiatives fail by taking on too much, too fast, underestimating the continuing resource commitment required for success. It is not enough to come up with the great idea. The idea must be vetted and embraced by a very diverse constituency. Implementation must be planned, resourced, monitored, and guided if real change is to be effected.

To be successful, this effort must be viewed and managed as a program with time-phased and prioritized actions. These actions provide the bases for the critical path that dictates the direction, magnitude, and speed in which to proceed. Without a doubt, the first item on the critical path is an understanding of where the effort fits on the list of current administration priorities. Without proper support from senior DoD leadership, this endeavor will become just another good idea not properly executed and resourced. Therefore, the top priority moving forward will be to secure the proper commitment from the administration to ensure this good work lives on and produces the transformation required for the good of our national defense.

There are a number of considerations that determine critical path. The current economic situation demands, however, that actions with a quick potential return on investment become the priority. Another consideration will be opportunities that offer potential offsets, adding something but forgoing an existing effort. While some of these choices will be intuitively obvious, many will require a detailed review and a formal comparison against other new and existing opportunities.

As discussed in Chapter 3, this will necessarily be a portfolio management approach that enables the governance structure to make informed enterprise-wide decisions. Once these portfolio elements are in place, the governance structure can proceed with prioritizing and assigning responsibilities for the actions necessary to move the product support improvement to its next level within budgetary constraints.

Simply put, the critical path to PSAT success is:

- OSD provides strong stakeholder support from the administration
- Military Services interpret and implement the report for Service immediate and long-term use
- Industry embraces the intent of PSAT and infuses it in all existing developmental design and sustainment efforts
- Stand up PSEC to monitor and guide the effort

# Appendix A: PSAT Weapon System Data Analysis

This appendix describes the collection and analysis process used in the final Product Support Assessment Team (PSAT) report.

## Weapon System Population

The PSAT weapon system population (Figure 24) was selected to accomplish two main objectives:

1. Contain a diverse range of product support strategies to make the analyses options as broad as possible and minimize the likelihood of bias errors
2. Capture a complete picture of operating and support (O&S) cost, availability data, and documented support strategies to ensure data-driven analysis and recommendations

The selected weapon systems accomplish these objectives. Most have seen extensive use in the last two wars, all represent a solid mix of product support strategies across Services and battle spaces, and all have relatively complete quantitative and qualitative data pictures available.

Most of the 34 weapon systems are a subset of a larger number suggested by the Services, though a few weapon systems were added by the PSAT analysts to broaden the overall population. Due to legacy information systems, and because not all of the data requested is typically captured by the Services, data gaps existed. Therefore, these 34 weapon systems represent the entirety of systems for which the PSAT analysts were able to get complete data.

***Figure 24: PSAT Weapon System Analyses Used Extensive Cost and Performance Data from Each of These Weapon Systems***

**Fixed-Wing Fighter/Attack**
- F/A-18 C/D
- F/A-18 E/F
- F-117
- F-15
- F-16
- F-22
- A-10

**Bomber**
- B-2
- B-52
- B-1

**Fixed-Wing Patrol**
- AWACS
- P-3
- JSTARS

**Fixed-Wing Cargo**
- C-130
- C-5
- C-17
- KC-135

**Rotary Wing**
- AH-64 A
- AH-64 D
- HH-60
- UH-60
- MH-60 (Army)
- SH-60
- CH-47 D

**Land Assault**
- AAV
- Bradley
- Stryker
- M1 FOV (Army)
- M1 Abrams (USMC)

**Land Transport**
- FMTV
- MTVR
- HEMTT
- HMMWV (Army)
- HMMWV (USMC)

## Data Requested and Received

The OSD released a call for data from the DoD Service Components in February 2009. All four Services provided data in accordance with this data call. Specific data initially requested is shown in Figure 25. Due to different databases and data collection methods, each Service's response was slightly different than the others, with discrepancies ranging from how availability was captured or recorded to whether documented sustainment strategies were available. Follow-up questions were asked directly to Service Secretariat representatives to help fix discrepancies within the PSAT dataset; these representatives universally provided prompt help in getting additional data or helping interpret the data that was provided.

***Figure 25: Quantitative and Qualitative Questions Asked in the February 2009 OSD Data Call***

1. **Support strategy**
   - In a few paragraphs, describe your support strategy, including O-/I-/D-level maintenance for all logistics elements
   - Was your strategy consistent over the past 10 years? If not, why? What changed?
2. **Lessons learned**
   - What were/are your lessons learned for support strategy success?
   - What were/are inhibitors for support strategy success?
3. **Performance management**
   - What are your performance measures/metrics?
   - How do you define/measure them?
4. **Program data for last 10 years**
   - Availability
   - Reliability
   - Ownership cost (to be provided by JB/CNR)
   - Depot maintenance man-hours
   - Depot man-hours via partnering
5. **Provide a one-paragraph description of the weapon system and its intended use. Was this a rapid fielding?**
6. **Where is the weapon system in its life cycle?**
7. **What are expectations for life cycle management and weapon system readiness during future reviews and throughout the sustainment period?**

Specific data reported in response to the data call varied. Support strategies were not always formally documented since older programs were not required to document those strategies. This made reconstruction of support strategies from publicly available sources and interviews with support managers the rule rather than the exception. Lessons learned were also not easily captured since most programs do not have a database maintaining these lessons; because of the work needed to construct lessons learned, the only times lessons learned were investigated were to clarify possible nuances in weapon systems data and aid in correct interpretation. In every case, Services were able to provide availability data; in some cases, though, there was a possibility that what was actually reported was operational availability versus materiel availability, demonstrating that the reporting of availability is still maturing. Also, reliability data is not universally tracked (though it should be); reinforcing the importance of tracking and reporting this data is part of the metrics strategy recommendation. All depot partnership data

came from a database that was only kept from 2002 to 2006, so it was of limited use. But, as with reliability data, such information can be of extraordinary importance and is part of the focus of the industrial integration strategy recommendation. Regarding the remaining questions, little data was collected since end-to-end life cycle product support maps (from acquisition to retirement) have not been a requirement for programs to develop or maintain.

### Databases Used

The Services all provided quantitative data. The Services all authorized access to their O&S databases to allow the PSAT analysts to collect additional data and to cross-check provided data. In every case, the data provided by the Services directly was used rather than that pulled from a database, making the assumption that the data provided by the Services' expert analyst is more accurate than that pulled by an external analyst from the Services' database. All discrepancies between the two data sources were discussed by the Service representative to understand why the discrepancies exist, and to highlight the need for an enterprise-spanning data collection and reporting system. As a supplement to the Services' databases, the OSD also provided access to several years worth of Defense Readiness Reporting System (DRRS) reports; this data helped fill gaps in the dataset that the Services' database access and interviews with Service experts could not close. A listing of the databases used is shown in Figure 26.

***Figure 26: Several Databases Helped Fill Data Gaps after Conducting the OSD Data Call and Subsequent Specific Data Requests***

| | |
|---|---|
| Army | Operating and Support Management Information System (OSMIS) |
| Air Force | Air Force Total Ownership Cost (AFTOC) |
| Navy | Visibility and Management of Operating and Support Costs (VAMOSC) |
| USMC | Visibility and Management of Operating and Support Costs (VAMOSC) |
| OSD | Defense Readiness Reporting System (DRRS) |

### Additional Data Sources

As previously mentioned, sustainment strategies often had to be reconstructed based on publicly available information on how programs are actually being sustained. Specific sources used in this analysis are listed in the "Qualitative Data Source" and "Quantitative Data Source" columns of Appendix B.

### Analysis Tools Used

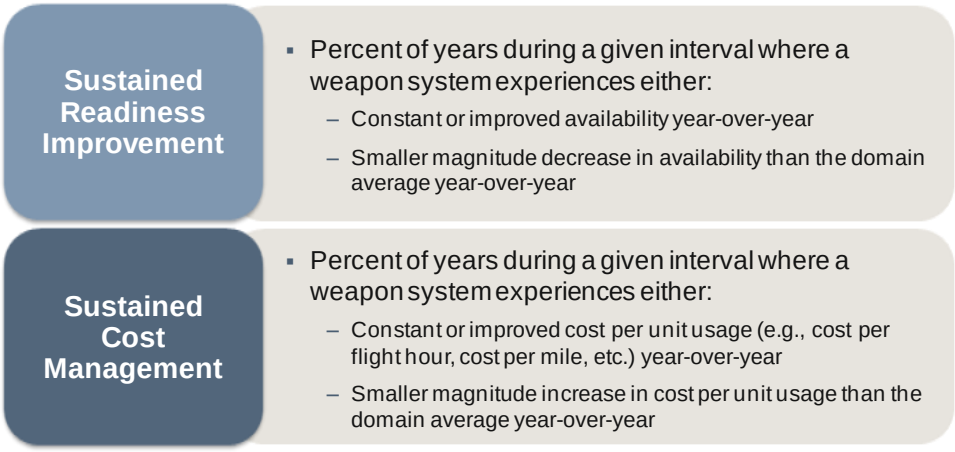
All analysis was conducted using Microsoft Excel 2007.

### Sustained Readiness Improvement and Sustained Cost Management Overview

The intent of the PSAT weapon system analyses is to understand the product support strategies that lead to improved readiness. Even divided within respective domains (as was shown in

Figure 27), every weapon system is different enough that direct comparison of availability numbers between programs is difficult and generally irrelevant. This is because every weapon system has a unique story explaining exactly why its availability numbers are what they are, including different availability goals and system design aspects, which may preclude higher or lower availability metrics. **Normalization of weapon system availability data was needed to allow cross-platform comparison, and the normalization method chosen was to examine how weapon system availability within a domain trended on a year-over-year basis in comparison to its domain peers.**

***Figure 27: Program Uniqueness Required a Relative Comparison across Similar Domains***




This examination of year-over-year trending with respect to peers required metrics developed for this analysis called "Sustained Readiness Improvement" (SRI) and "Sustained Cost Management" (SCM). These metrics are defined in words below.

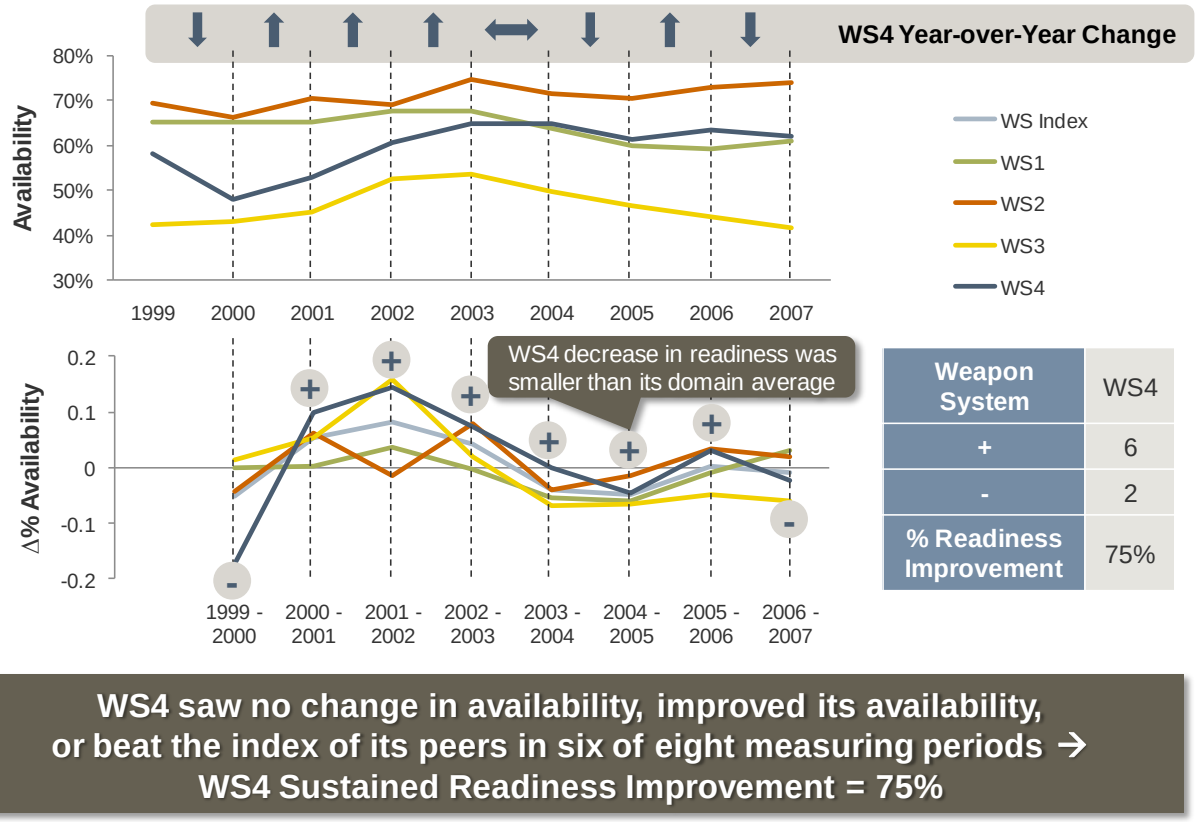
These metrics are critical for at least three reasons:

1. They show those support strategies that better manage adverse variability—every weapon system program faces adversity, such as contingency response, fleet groundings, and insufficient funding, so programs with strategies that manage variability in O&S and availability better than their peers score higher than those that do not.
2. They identify support strategies that contribute to year-over-year improvement to cost and readiness—even when there are few adverse events a program must contend with, such as a benign steady state between major contingencies, strategies that influence continual improvement or at least achieve a status quo of static cost and availability score higher SRI and SCM.
3. They allow comparisons of support strategies by normalizing for Operational Tempo (OPTEMPO) and domain—within a domain, all assets analyzed by the PSAT weapon system analysis team tended to experience OPTEMPO changes together, removing from the analysis equation one of the largest variables that drive availability.

## Sustained Readiness Improvement and Sustained Cost Management Derivation

Sustained Readiness Improvement can be shown graphically in Figure 28. Using the example weapon system, WS4 availability changes each year and this change is compared to its peers, WS1, WS2, and WS3. Between 1999 and 2000, WS4 experienced a decrease in availability and that decrease was greater than the average of its peers, so WS4 was counted as having not sustained a readiness improvement for that period. Compare this to between 2000 and 2001, when WS4 saw an improvement in availability and was counted as having sustained a readiness improvement that period. Jump ahead to between 2003 and 2004, when WS4 saw no change in availability; this zero-change counted as a sustained readiness improvement period. Finally, between 2004 and 2005, WS4 saw a decrease in availability, but that decrease was equal to the average decrease; WS4 also counted a sustained readiness improvement for this period. There are eight measurement periods across the time frame of 1999 through 2007 and, for six of them, WS4 demonstrated a sustained readiness improvement. Therefore, the Sustained Readiness Improvement for WS4 is 75 percent. Sustained Cost Management is derived identically, except that where decreases in availability greater than a domain's average yielded no sustained readiness improvement, increases in cost per unit of usage greater than a domain's average yield no sustained cost management for a period.

***Figure 28: Sustained Readiness Improvement Is Equivalent to Taking a "First Derivative" of Availability Data and Allows Comparison of Trends across Weapon System Programs within a Domain***



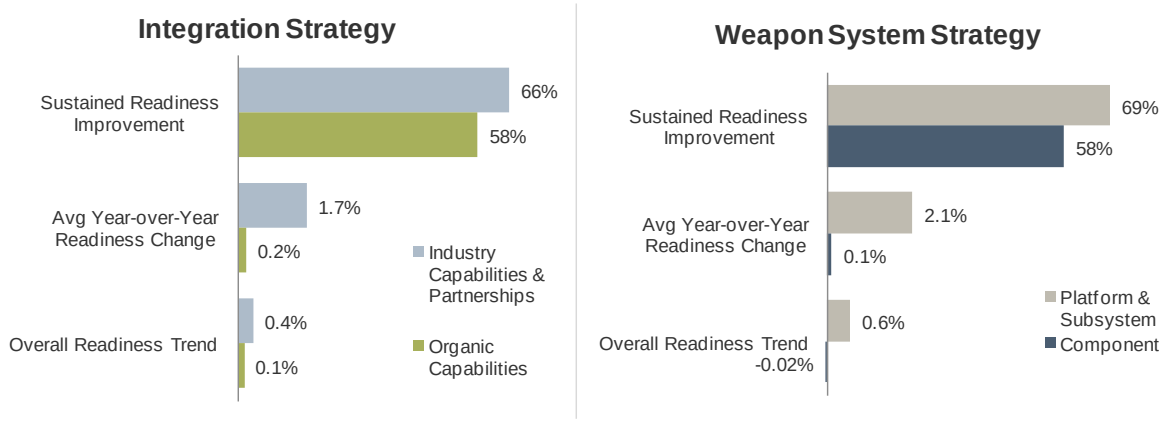

**WS4 saw no change in availability, improved its availability, or beat the index of its peers in six of eight measuring periods → WS4 Sustained Readiness Improvement = 75%**

## Analyses Results

Several analyses using Sustained Readiness Improvement and Sustained Cost Management were performed with additional analyses using "year-over-year" availability and cost changes and "average trend of availability over the measurement period" serving as corroboratory evidence. Availability and cost results are shown in Figure 29.

One potentially significant additional line of analysis that was not able to be performed due to a scarcity of data was assessing the impact of optimally funding weapon system sustainment. Anecdotal evidence suggests that optimally funding weapon system sustainment plays a role in ensuring higher or improving availability over time, and that optimally funding sustainment may be the underlying cause of the success PBL has in achieving higher readiness levels since PBL creates "must-pay" bills that ensure some set level of funding. Unfortunately, it is difficult to define what optimally funded means and even more difficult to determine whether any or all of the 34 analyzed weapon systems were optimally funded, so this analysis was not able to be conducted. Although this is not a formal process recommendation, this lack of data highlights that a fundamental way to improve product support management is to define, collect, report, and manage the data needed to drive effective life cycle product support.

***Figure 29: Partnering with Industry at the Subsystem and Platform Level Leads to Higher Sustained Readiness Improvement***

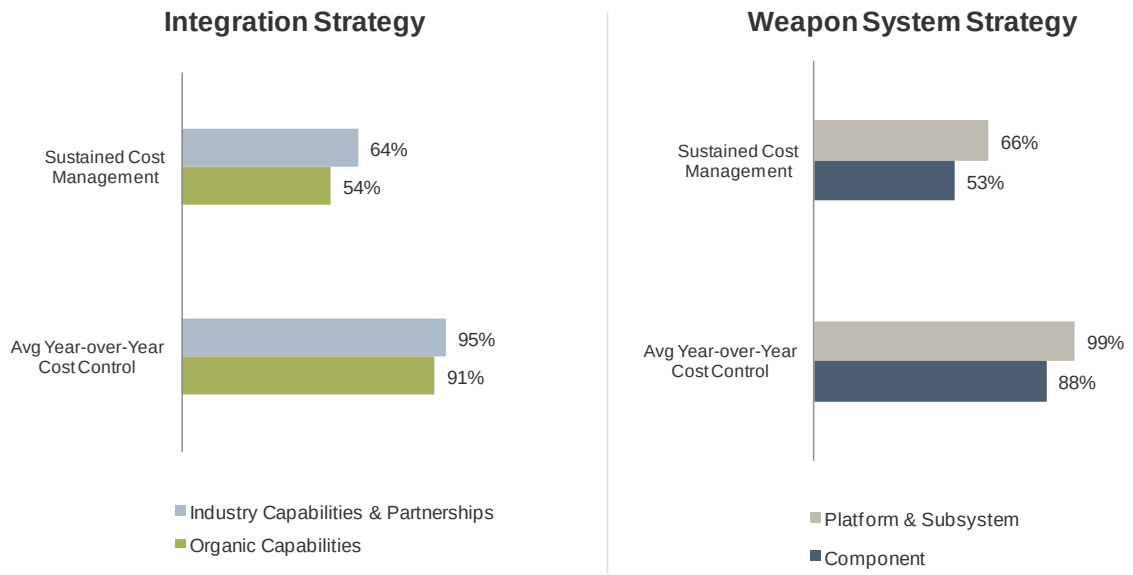



**Regression modeling also tells us with >95% certainty that adopting a subsystem or platform weapon system strategy yields 11% higher Sustained Readiness Improvement than a component strategy**

Notes:

1. Sustained Readiness Improvement (SRI) is the number of years over the span of 1999 through 2007 where a weapons system saw no decline in availability or saw a decline of lesser magnitude than the domain average
2. Average year-over-year readiness change examines the same dataset as SRI
3. Overall readiness trend is the average trend in availability over the time frame used in calculating SRI
4. Actual regression model is: SRI = 58% + 11%X, where X is 1 if weapon system strategy is platform or subsystem and 0 if it is component; ANOVA yields Significance-F of 0.035, coefficient of regression for X has a P-value of 0.035, $R^2 = 0.13$

***Figure 30: Systems with Better Sustained Cost Management Used Subsystem and Platform-Level Partnering Strategies***

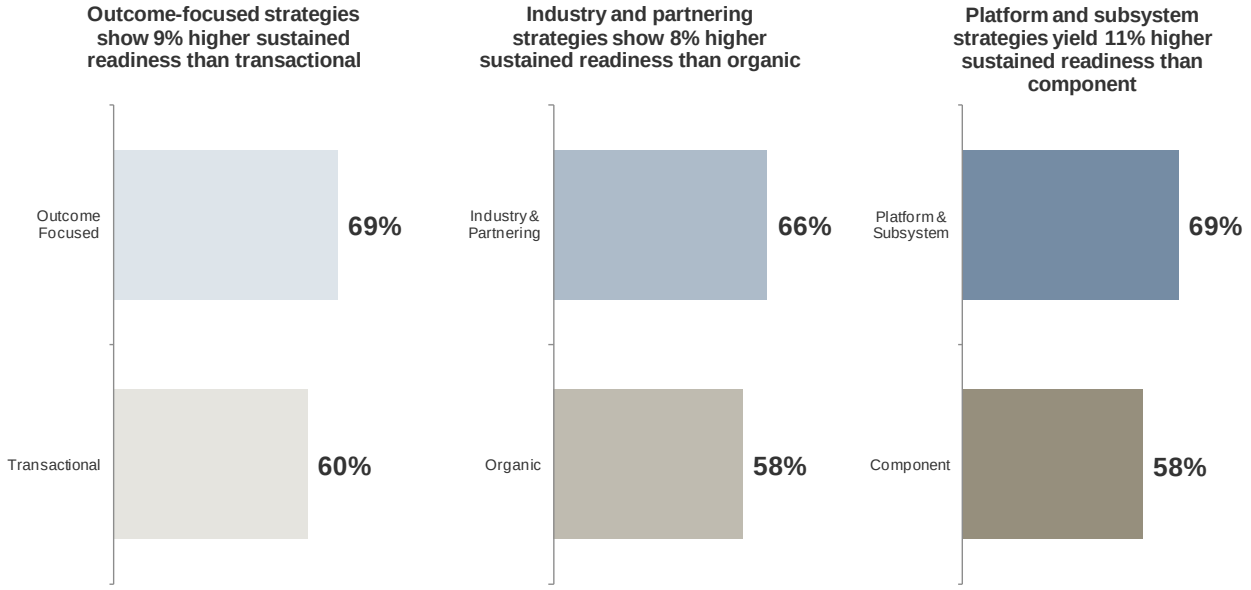



Notes:

1. Sustained Cost Management is the number of years over the span of 1999 through 2007 where a weapons system saw no increase in cost per unit usage or saw a increase of lesser magnitude than the domain average
2. Average year-over-year cost control = 1 – average year-over-year cost change across all weapon systems studied; for example, if a given weapon system saw an average year-over-year cost change of 10% per year, it would have an average year-over-year cost control of 90%, meaning that, for this metric, higher numbers are better than lower numbers

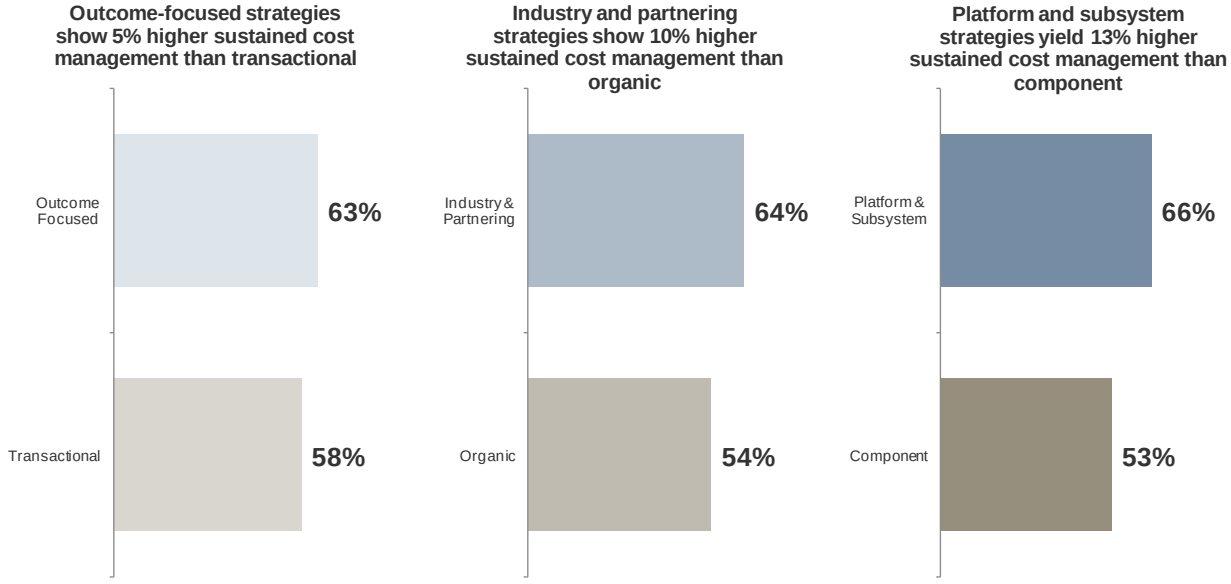
Looking at just the Sustained Readiness Improvement and Sustained Cost Management metrics, the points made in the Next-Generation Business Model write-up are shown to be true, as seen in the following diagrams. Alternative detailed displays of how the weapon system data are aligned against the various strategies tested are shown below. Detailed rationales of why these weapon systems are aligned in this manner are contained in Appendix B.

## *Figure 31: Subsystem and Platform-Level Industry Partnerships Designed to Achieve Target Outcomes Yield Higher Sustained Readiness Improvement*




Notes:
1. Sustained Readiness Improvement is the number of years over the span of 1999 through 2007 where a weapon system saw no decline in availability or saw a decline of lesser magnitude than the domain average
2. F-22, FMTV, MTVR, and Stryker data does not span from 1999 through 2007 due to their newness
3. USAF C-130 APU contract awarded to Honeywell in August 2007—not enough time has occurred yet to include it as a partnership for this evaluation

## *Figure 32: Subsystem and Platform-Level Industry Partnerships Designed to Achieve Target Outcomes Manage Cost Best*




Note:
1. Sustained Cost Management is the number of years over the span of 1999 through 2007 where a weapon system saw no increase in cost per unit usage or saw a increase of lesser magnitude than the domain average

*Figure 33: Outcome-Focused Support Strategies Produce Higher Readiness Improvement*

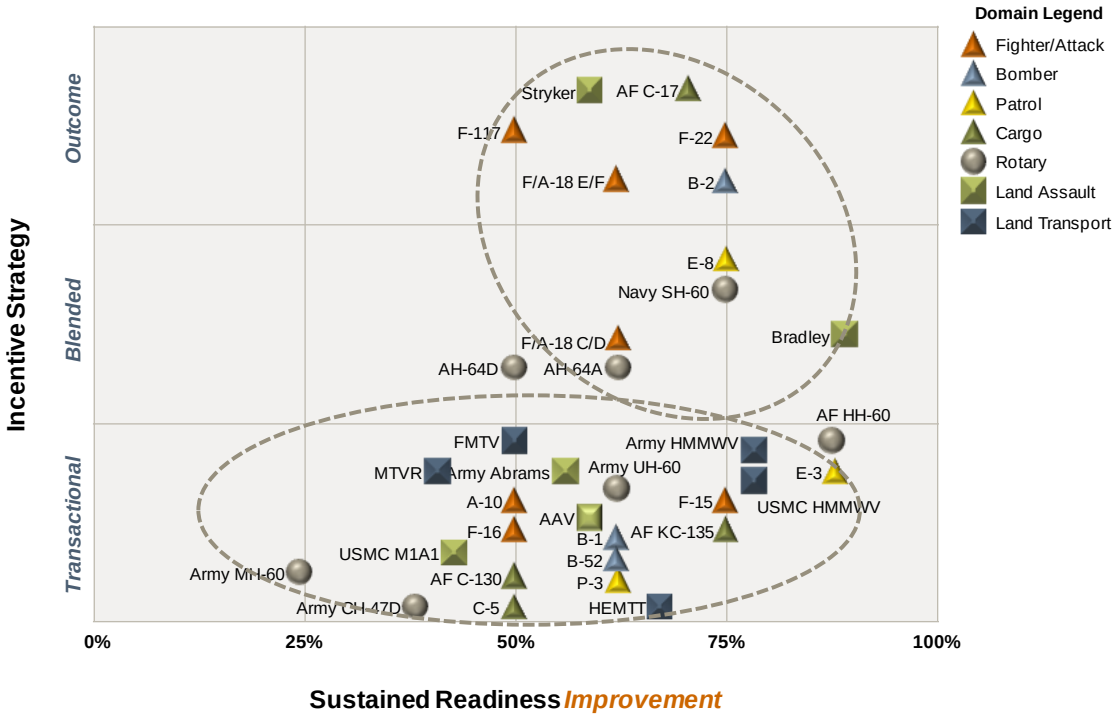
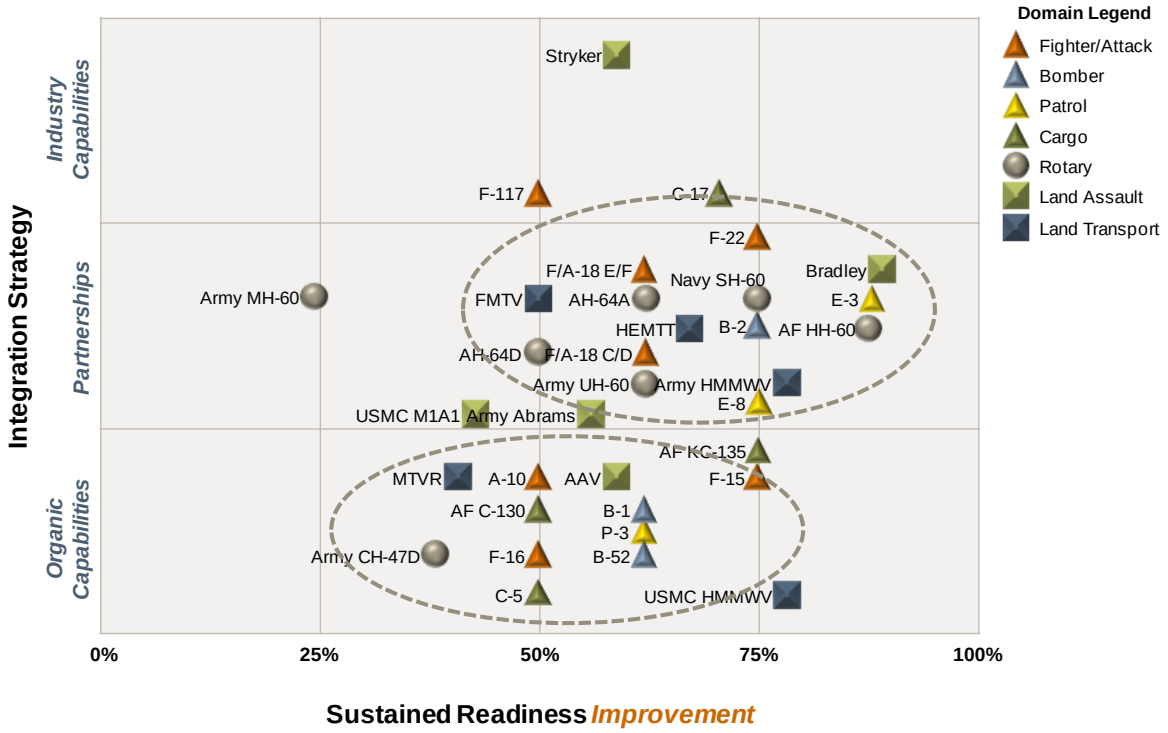



*Figure 34: Industry and Partnering Strategies Produce Higher Sustained Readiness Improvement*



## *Figure 35: Subsystem and Platform Strategies Yield Higher Sustained Readiness Improvement*

Notes:
1. Sustained Readiness Improvement is the number of years over the span of 1999 through 2007 where a weapon system saw no decline in availability or saw a decline of lesser magnitude than the domain average
2. F-22, FMTV, MTVR, and Stryker data does not span from 1999 through 2007 due to their newness
3. USAF C-130 APU contract awarded to Honeywell in August 2007—not enough time has occurred yet to include it as a partnership for this evaluation

## *Figure 36: Industry and Partnering Comprise Almost 100% of High-Upside Strategies*

*Figure 37: Outcome and Blended Strategy Costs Are at Least as Predictable as Transactional*

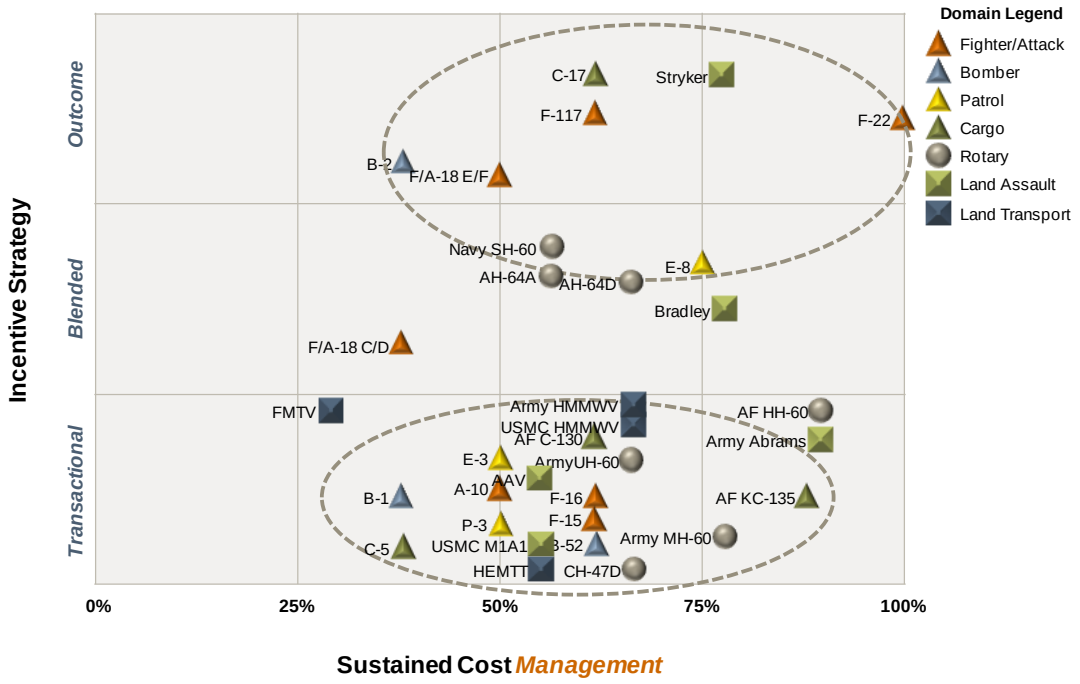
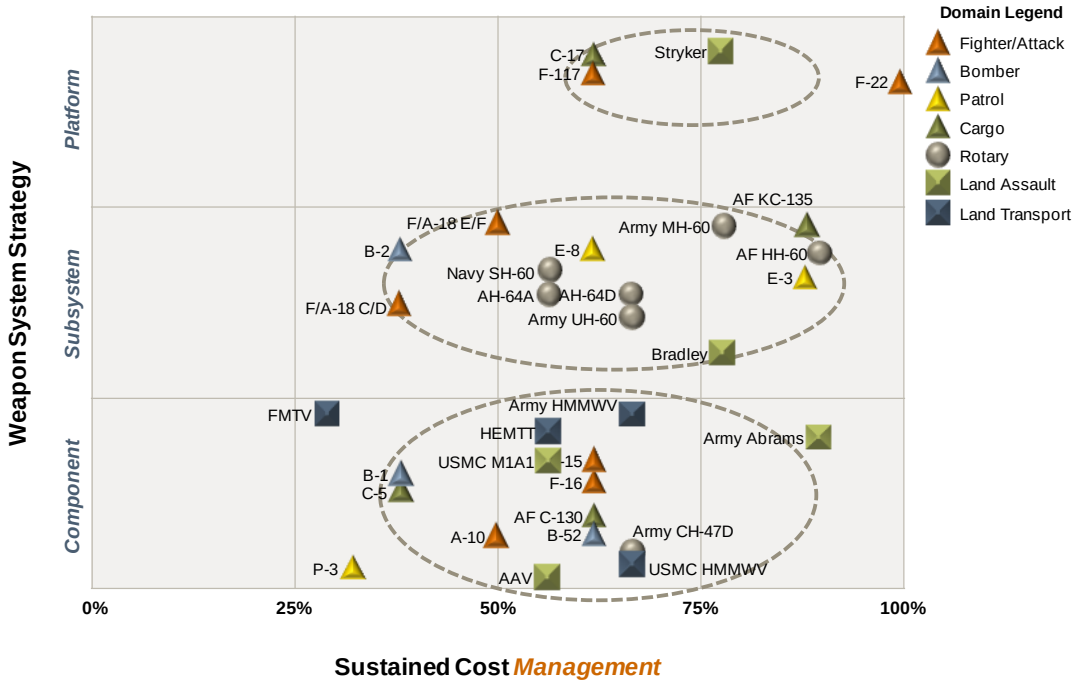



*Figure 38: Subsystem and Platform Strategies Yield Same or Better Cost Management*




Note:
1. Sustained Cost Management is the number of years over the span of 1999 through 2007 where a weapon system saw no increase in cost per unit usage or saw a increase of lesser magnitude than the domain average

## Appendix B: PSAT Weapon System Data Sources and Strategy Assignation Rationale

### Introduction

Table 4 documents the sources used in the analyses detailed in Appendix A. It explains the rationale behind each weapon system's strategy categorization and the qualitative and quantitative data source used. Hyperlinks to source documents are provided whenever possible and detailed notes are at the end of this appendix that explain to future analysts how to duplicate creation of the dataset used in Appendix A's analyses.

***Table 4: Rationale behind Weapon Systems Strategy Category Assignation***

| **Weapon System** | Incentive Strategy | Weapon System Strategy | Integration Strategy | Qualitative Data Source | Quantitative Data Source |
|---|---|---|---|---|---|
| **A-10** | Transactional—no outcome-based contracts identified | Component—no integrated subsystem or platform-level management identified | Program Office is the PSI for all support | Comprehensive literature survey uncovered no outcome-centric or partnering strategies | Note 1 |
| **AAV** | Transactional—no outcome-based contracts identified | Component—no integrated subsystem or platform-level management identified | Organic—no industry product support partnering identified, though there is a suspect partnership that ended in 2006 with United Defense where UDLP uses unutilized USMC warehouse space to conduct its work on upgrading AAVs | Comprehensive literature survey uncovered no outcome-centric strategies<br>OSD website: http://www.acq.osd.mil/log/mpp/depot_partnerships/Marine_Corps_Snapshot_Synopsis_18_APR_05.pdf | O&S: Note 2<br>Availability: DRRS<br>Cost per unit usage: Note 2 |

| | | | | | |
|---|---|---|---|---|---|
| **Abrams (Army)** | Transactional—no outcome-based contracts identified | Component—no integrated subsystem or platform-level management identified | PBP—General Dynamics is completely refurbishing and upgrading M1A1 MBTs via the Abrams Integrated Management contract | Note 6<br>Comprehensive literature survey uncovered no outcome-centric strategies<br>United Press: http://www.upi.com/Security_Industry/2008/09/08/General-Dynamics-to-refurbish-Abrams-tanks/UPI-71071220906735/ | O&S: OSD data call U.S. Army response<br>Availability: OSD data call U.S. Army response<br>Cost per unit usage: Note 3 (Abrams) |
| **Abrams (USMC)** | Transactional—no outcome-based contracts identified | Component—no integrated subsystem or platform-level management identified | PBP—USMC Abrams is being repaired at the same facility that USA Abrams are being repaired; we suspect it is benefiting from the Abrams Integrated Management | Comprehensive literature survey uncovered no outcome-centric strategies<br>Verifying PBP assertion with the USMC | O&S: Note 2<br>Availability: DRRS<br>Cost per unit usage: Note 2 |
| **AH-64A** | Blended—target acquisition designation sight/pilot night vision sensor (TADS/PNVS) PBL | Subsystem—target acquisition designation sight/pilot night vision sensor (TADS/PNVS) PBL<br>General Electric conducts modification, repair, and overhaul of T700 | PBP—depot overhaul and repair PPP contract for AH-64 A/D common components | Note 6<br>TADS/PNVS source: United Press http://www.upi.com/Security_Industry/2007/05/11/Lockheed-lands-PBL-contract-for-Apache/UPI-83911178917431/<br>T700 source: Defense Industry Daily http://www.defenseindustrydaily.com/651m-to-overhaul-t700-family-helicopter-engines-updated-0821/<br>PBP source: OSD data call army response | O&S: OSD data call U.S. Army response<br>Availability: OSD data call U.S. Army response<br>Cost per unit usage: Note 3 (Apache) |

| | | | | | |
|---|---|---|---|---|---|
| **AH-64D** | Blended—target acquisition designation sight/pilot night vision sensor (TADS/PNVS) PBL | Subsystem—target acquisition designation sight/pilot night vision sensor (TADS/PNVS) PBL<br>General Electric conducts modification, repair, and overhaul of T700 | PBP—depot overhaul and repair PPP contract for AH-64 A/D common components | Note 6<br>TADS/PNVS source: United Press http://www.upi.com/Security_Industry/2007/05/11/Lockheed-lands-PBL-contract-for-Apache/UPI-83911178917431/<br>T700 source: Defense Industry Daily http://www.defenseindustrydaily.com/651m-to-overhaul-t700-family-helicopter-engines-updated-0821/<br>PBP source: OSD data call army response | O&S: OSD data call U.S. Army response<br>Availability: OSD data call U.S. Army response<br>Cost per unit usage: Note 3 (Apache) |
| **B-1** | Transactional—no outcome-based contracts identified | Component—no integrated subsystem or platform-level management identified | Organic partnership with OC-ALC for software support | Comprehensive literature survey uncovered no outcome-centric or partnering strategies | Note 1 |
| **B-2** | Outcome—total systems support partnership (TSSP) est. 2002, all-encompassing PBL est. in 2007 | Subsystem—total systems support partnership (TSSP) est. 2002, all-encompassing PBL est. in 2007 | PBP—NG is the PSI for the all encompassing PBL for organic and industry support providers that started in 2007 | Note 6<br>Source: Secretary of Defense Performace Based Logistics Awards Program for Excellence in Performace Based Logistics August 2007<br>SpaceWar article: http://www.spacewar.com/reports/Northrop_Grumman_Awarded_Contract_To_Implement_More_Efficient_Way_To_Support_B_2_Bomber_999.html | Note 1 |

| | | | | | |
|---|---|---|---|---|---|
| **B-52** | Transactional—no outcome-based contracts identified | Component—no integrated subsystem or platform-level management identified | Program Office is the PSI for all support | Note 6 Comprehensive literature survey uncovered no outcome-centric or partnering strategies | Note 1 |
| **Bradley** | Blended—Improved Bradley Acquisition Subsystem (IBAS) TOW missile launcher is part of the award for the Improved Target Acquisition System (ITAS) | Subsystem—Improved Bradley Acquisition Subsystem (IBAS) TOW missile launcher is part of the award for the Improved Target Acquisition System (ITAS) | PBP—Bradley Remanufacture Program is a partnership with BAE Systems at Red River Army Depot | Note 6 IBAS source: Raytheon news release http://www.prnewswire.com/cgi-bin/micro_stories.pl?ACCT=910473&TICK=RTNB12&STORY=/www/story/02-27-2006/0004306551&EDATE=Feb+27,+2006 Remanufacture: Defense Industry Daily article http://www.defenseindustrydaily.com/the-us-armys-bradley-remanufacture-program-updated-02835/ | O&S: OSD data call U.S. Army response Availability: OSD data call U.S. Army response Cost per unit usage: Note 3 (Bradley) |
| **C-5** | Transactional—no outcome-based contracts identified | Component—no integrated subsystem or platform-level management identified | Program Office is the PSI for all support | Note 6 Comprehensive literature survey uncovered no outcome-centric or partnering strategies | Note 1 |
| **C-17** | Outcome—Globemaster III Sustainment Partnership | Platform—Globemaster III Sustainment Partnership | Industry—though this is arguably a PBP, Boeing is the single responsible entity for performance—its role is actually to determine where workload goes, including whether it goes to organic sources of supply | Note 6 Source: Defense Industry Daily http://www.defenseindustrydaily.com/did-focus-the-c17-global-sustainment-partnership-02756/ | Note 1 |

| | | | | | |
|---|---|---|---|---|---|
| **C-130 (Air Force)** | Transactional—no outcome based contracts identified | Component—no integrated subsystem or platform level management identified | Program Office is the PSI for all support | Note 6 Comprehensive literature survey uncovered no outcome-centric or partnering strategies | Note 1 |
| **CH-47D** | Transactional—no outcome-based contracts identified | Component—no integrated subsystem or platform-level management identified | Program Office is the PSI for all support | Comprehensive literature survey uncovered no outcome-centric or partnering strategies | O&S: not required Availability: DRRS Cost per unit usage: Note 3 (Chinook) |
| **E-3 AWACS** | Transactional—no outcome-based contracts identified | Subsystem—avionics and engine life cycle management through the Boeing and USAF partnership at Oklahoma City ALC | PBP – Boeing provides engineering support while the Program Office integrates all other sustainment functions | Note 6 Comprehensive literature survey uncovered no outcome-centric strategies Source: Integrator USAF newspaper article http://integrator.hanscom.af.mil/2005/June/06022005/06022005-01.htm Integration Strategy source: USAF SAF/IEL | Note 1 |
| **E-8 JSTARS** | Blended—JSTARS Total Systems Support Responsibility (TSSR) partnership between the USAF and Northrop Grumman, but much of the aircraft is transactional | Subsystem—JSTARS Total Systems Support Responsibility (TSSR) partnership between the USAF and Northrop Grumman; NG is PSI on multiple subsystems | PBP—JSTARS Total Systems Support Responsibility (TSSR) partnership between the USAF and Northrop Grumman; NG is PSI on multiple subsystems | Department of Defense Awards Program for Excellence in Performace Based Logistics Nomination, 5 August 2005 | Note 1 |
| **F-15** | Transactional—no outcome-based contracts identified | Component—no integrated subsystem or platform-level management identified | Program Office is the PSI for all support | Note 6 Comprehensive literature survey uncovered no outcome-centric or partnering strategies | Note 1 |

| | | | | | |
|---|---|---|---|---|---|
| **F-16** | Transactional—no outcome-based contracts identified | Component—no integrated subsystem or platform-level management identified | Program Office is the PSI for all support | Comprehensive literature survey uncovered no outcome-centric or partnering strategies | Note 1 |
| **F/A-18 C/D** | Blended—Honeywell APU and GE F404 engine are incentivized on availability, but much of the aircraft is transactional | Subsystem—Honeywell APU, GE F404 engine, and tires are all managed as discrete entities to drive overall F/A-18 C/D availability | PBP—there is a combination of industry and organic partners responsible for the aircraft | F404 source: NAVICP PBL training deck http://www.acquisition.gov/comp/aap/documents/Appendices/APPENDIX%2012%20-%20NavyPBL50505.pdf APU source: NAVICP Honeywell APU case study http://www.dtic.mil/ndia/2001systems/tonoff.pdf | O&S: Note 4 Availability: NAVAIR provided data, May 2009 Cost per unit usage: Note 5 |
| **F/A-18 E/F** | Outcome—Honeywell, APU, GE F404; Boeing F/A-18 FIRST manages majority of the rest of the airframe | Subsystem—Honeywell, APU, GE F404, Michelin and LMCO tires; Boeing F/A-18 FIRST manages majority of the rest of the airframe | PBP—Boeing manages much of the aircraft, with GE managing engines and Honeywell managing APUs, but major sources of supply are the organic depots | Note 6 F/A-18 FIRST source: Navy Enterprise website http://www.navyenterprise.navy.mil/stories/fa-18-super-hornet-celebrates.aspx F404 source: NAVICP PBL training deck http://www.acquisition.gov/comp/aap/documents/Appendices/APPENDIX%2012%20-%20NavyPBL50505.pdf APU source: NAVICP Honeywell APU case study http://www.dtic.mil/ndia/2001systems/tonoff.pdf | O&S: Note 4 Availability: OSD data call US Navy response Cost per unit usage: Note 5 |

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|---|---|---|---|---|---|
| **F-22** | Outcome—Follow-on Agile Sustainment for the Raptor (FASTeR); the engine contract is called Sustainment Program for the Raptor Engine (SPaRE) | Platform—Follow-on Agile Sustainment for the Raptor (FASTeR); the engine contract is called Sustainment Program for the Raptor Engine (SPaRE) and uses organic and contractor sources of supply | PBP—There are two PBP's; one for the engine with P&W and OC ALC, and one for the airframe with OO ALC. LMA is the PSI and has supply support and sustaining engineering, other product support functions. Current approach through the BCA is a partnership where maintenance is organic and product support is blended. | Source: OSD data call USAF response, USAF SAF/IEL | Note 1 |
| **F-117 (this system is retired)** | Outcome—F-117 Total System Support Partnership (TSSP) award fee was based on performance outcomes | Platform—F-117 TSSP placed Lockheed Martin responsible for most elements of F-117 sustainment | Industry—F-117 TSSP placed Lockheed Martin responsible for most elements of F-117 sustainment | Source: USAF brief on F-117 PBL https://acc.dau.mil/GetAttachment.aspx?id=46633&pname=file&aid=13906&lang=en-US | Note 1 |
| **FMTV** | Transactional—no outcome-based contracts identified | Component—no integrated subsystem or platform-level management identified | PBP—family of medium tactical vehicles reset program at Stewart & Stevenson in Sealy, Texas | Note 6 Comprehensive literature survey uncovered no outcome-centric strategies Source: Army Logistician magazine http://www.almc.army.mil/alog/issues/SepOct05/resetfmtv.html | O&S: OSD data call U.S. Army response Availability: OSD data call U.S. Army response Cost per unit usage: Note 3 (MTV Series) |
| **HEMTT** | Transactional—no outcome-based contracts identified | Component—no integrated subsystem or platform-level management identified | PBP—Red River Army Depot and Oshkosh Truck Corporation partnership to remanufacture HEMTTs | Source: Global Security http://www.globalsecurity.org/military/library/news/2006/10/mil-061002-arnews03.htm | O&S: not required Availability: DRRS Cost per unit usage: Note 3 (HEMTT Series) |

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|---|---|---|---|---|---|
| **HH-60** | Transactional—no outcome-based contracts identified | Subsystem—General Electric conducts modification, repair, and overhaul of T700 | PBP—General Electric conducts modification, repair, and overhaul of T700; Sikorsky provides parts and kits to the Corpus Christi Army Depot Pavehawk (HH-60) repair line | Comprehensive literature survey uncovered no outcome-centric strategies<br>T700 source: Defense Industry Daily http://www.defenseindustrydaily.com/651m-to-overhaul-t700-family-helicopter-engines-updated-0821/<br>Sikorsky—CCAD partnership Source: Army Business Transformation Knowledge Center article http://armybtkc.army.mil/docs/CorpusChristi_000.pdf | Note 1 |
| **HMMWV (Army)** | Transactional—no outcome-based contracts identified | Component—no integrated subsystem or platform-level management identified | PBP—customer pay agreement between AM General LLC and DLA for recapitalization at Red River Army Depot, Letterkenny Army Depot, and Maine Military Authority | Comprehensive literature survey uncovered no outcome-centric strategies<br>Source: DSCC DLA website http://www.dscc.dla.mil/offices/land/custops.html | O&S: not required<br>Availability: DRRS<br>Cost per unit usage: Note 3 (HMMWV Series) |

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|---|---|---|---|---|---|
| **HMMWV (USMC)** | Transactional—no outcome-based contracts identified | Component—no integrated subsystem or platform-level management identified | Organic—though DSCC DLA Integrated Logistics Partnership Division, which manages customer pay, states on its website that it is participating in the multiple award schedule for USMC HMMWV, this is probably still organically supported | Comprehensive literature survey uncovered no outcome-centric strategies Source: DSCC DLA website http://www.dscc.dla.mil/offices/land/custops.html | O&S: Note 2 Availability: DRRS Cost per unit usage: Note 2 |
| **KC-135** | Transactional—no outcome-based contracts identified | Might be platform but considering it to be a subsystem strategy in case only major portions of the plane are worked on during PDM—entire plane used to take 214 days to make it through contractor vendor repair line but is now taking 175 days or less to complete PDM, which directly raises availability numbers | Program Office is the PSI—according to the USAF, the relationship between Boeing, and the USAF, under the KC-135 Programmed Depot Maintenance program, is transactional | Note 6 Comprehensive literature survey uncovered no outcome-centric strategies Source: OSD data call, USAF SAF/IEL response and Boeing Frontiers online http://www.boeing.com/news/frontiers/archive/2006/april/i_ids1.html | Note 1 |

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|---|---|---|---|---|---|
| **MH-60 (Army)** | Transactional—no outcome-based contracts identified | Subsystem—General Electric conducts modification, repair, and overhaul of T700 | PBP—DynCorp conducts organization-level, intermediate, and depot-level aviation maintenance, special repairs, and servicing of electronic components | Note 6 Comprehensive literature survey uncovered no outcome-centric strategies Source: Business Wire http://findarticles.com/p/articles/mi_m0EIN/is_2009_Feb_12/ai_n31349972/ T700 source: Defense Industry Daily http://www.defenseindustrydaily.com/651m-to-overhaul-t700-family-helicopter-engines-updated-0821/ | O&S: OSD data call U.S. Army response Availability: OSD data call U.S. Army response Cost per unit usage: Note 3 (rather than MDS Name, the specific asset was identified) (MDS = MH-60K) |
| **MTVR** | Transactional—no outcome-based contracts identified | Component—no integrated subsystem or platform-level management identified | Program Office is the PSI for all support | Comprehensive literature survey uncovered no outcome-centric or partnering strategies | O&S: not collected Availability: DRRS Cost per unit usage: not calculated |
| **P-3 Orion** | Transactional—no outcome-based contracts identified | Component—no integrated subsystem or platform-level management identified | Program Office is the PSI for all support | Comprehensive literature survey uncovered no outcome-centric or partnering strategies | O&S: Note 4 Availability: NAVAIR provided data, May 2009 Cost per unit usage: Note 5 |

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|---|---|---|---|---|---|
| **SH-60** | Blended—only tip-to-tail and FLIR contracts are outcome-based—all other maintenance is transactional | Subsystem—tip-to-tail, FLIR, T700 | PBP—tip-to-tail and FLIR both partner with depots to conduct repairs | Source: NAVAIR H-60 PBL presentation https://acc.dau.mil/GetAttachment.aspx?id=46624&pname=file&aid=13897&lang=en-US T700 source: Defense Industry Daily http://www.defenseindustrydaily.com/651m-to-overhaul-t700-family-helicopter-engines-updated-0821/ | O&S: Note 4 Availability: NAVAIR provided data, May 2009 Cost per unit usage: Note 5 |
| **Stryker** | Outcome—the Stryker CLS was responsible for all levels of maintenance and supply support—it had an operational readiness rate requirement of ≥90% | Platform—the Stryker CLS was responsible for all levels of maintenance and supply support | Industry—The Stryker CLS was responsible for all planned and unplanned maintenance at all levels; as of 2008, Stryker CLS started transitioning to organic providers for all unscheduled maintenance | Source: OSD data call U.S. Army response | O&S: OSD data call U.S. Army response Availability: DRRS Cost per unit usage: Note 3 (Stryker) |
| **UH-60** | Transactional—no outcome-based contracts identified | Subsystem—General Electric conducts modification, repair, and overhaul of T700 | PBP—General Electric conducts modification, repair, and overhaul of T700 | Comprehensive literature survey uncovered no outcome-centric strategies T700 source: Defense Industry Daily http://www.defenseindustrydaily.com/651m-to-overhaul-t700-family-helicopter-engines-updated-0821/ | O&S: not required Availability: DRRS Cost per unit usage: Note 3 (Blackhawk) |

***Notes***

1. USAF O&S and availability data from AFCAP data downloaded February 2009; cost per unit usage uses AFCAP data elements "Missing ICS CY" and CAIGS CY_1_1,

CY_1_2, CY_1_3, CY_2_1, CY_2_2, CY_2_3, CY_2_4, CY_2_5, CY_3_3, CY_4_1, CY_4_2, CY_4_3, CY_4_4, CY_5_1, CY_5_2, CY_5_3, CY_6_1, CY_6_3, CY_6_4, CY_6_5, CY_6_6, CY_7_1, CY_7_2) divided by "Hours—Total"

2. All USMC Ground O&S cost comes from VAMOSC and equals the summation of "Regular RAC Parts_Total Parts Cost," "Deployed Parts_Total Parts Cost," "Regular Labor Cost_Total Labor Cost," "Deployed Labor Cost_Total Labor Cost," and "Depot Cost"; USMC ground cost per unit usage is [Average Unit OPTEMPO * Inventory]/[Ground O&S]
3. U.S. Army cost per unit usage is from Army OSMIS SSF O&S Class IX Summary, where the parameters are:
   - Time frame = 1999–2008
   - Weapon system is selected using MDS name and displayed in the table above in this format = "Note 3 [Insert MDS name here]"
   - Organization = All MACOMS
   - All quarters and all MACOMS are summed; all dollars are 2009 dollars
4. Naval Aviation O&S from VAMOSC using the folder named "ATMSR (97–Present)" and constant 2008 dollars
5. Naval Aviation cost per unit usage uses the sum of CAIGs 1, 2, 3, 4, 5, and 6, divided by the sum of regular and FRS "Total Annual Flying Hours"
6. Service sustainment strategy data was provided, but additional information was needed to develop determine overall strategy
7. Performance Based Partnership (PBP) is a partnership where there is a defined formal performance expectation between at least two organizations, where one partner performs any relevant product support function that complements the functions performed by the other partners

# Appendix C: Product Support Business Model Detailed Elements

## Introduction

Tables 6 through 12 document the initial supporting details of the product support business model (PSBM). These details use the Product Support Decision Matrix of Figure 11 as a reference and amplify key facets of the PSBM; these tables are not all-inclusive nor are they complete, since the PSBM will be refined and defined in much greater detail during its recommendation implementation. Table 5 provides an overview of the tables containing these supporting details.

***Table 5: Overview and Contents***

| Term | Definition |
|---|---|
| **Table 6: Target Metrics (Outcome Objectives)** | Outcome metrics that programs using a given strategy should use to measure their performance—Required (R), Optional (O), Not Applicable (N/A) |
| **Table 7: Representative Example Rationales** | Example situations to alert decision makers that particular product support strategies should be considered |
| **Table 8: Product Support Roles** | Product support tasks required for all strategies and the most likely task provider for a given strategy—Government (G), Industry (D), Best Value (BV) |
| **Table 9: Government and Industry Incentives** | Benefits Government and Industry will see by adopting a given strategy |
| **Table 10: Product Support Integrator Responsibility** | Specific outcomes for which Product Support Integrator is responsible |
| **Table 11: Analytic Tools Approach** | Type of decision making tool or decision-making cadence that will provide best life cycle product support outcomes |

*Table 6: Target Metrics (Outcome Objectives)*

| Strategy | System Materiel & Operational Availability | System Materiel Reliability | System O&S Cost | Non-Mission Capable Supply | Non-Mission Capable Maintenance | Mission Capable Rate | Depot Flow Days | Quality Discrepancy Rate | Subsystem Materiel Availability | Subsystem Materiel Reliability | Subsystem O&S Cost | Order Fulfillment Cycle Time | Repair Turn Around Time | Demand Plan Accuracy | Mean Time Between Failures | Inventory Turns |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.1 Industry-Centric Platform** | R | R | R | O | O | O | N/A | O | O | O | O | O | O | O | N/A | N/A |
| **1.2 Blended DoD-Industry Platform** | R | R | R | O | O | O | N/A | O | O | O | O | O | O | O | N/A | N/A |
| **1.3 DoD-Centric Platform** | R | R | R | O | O | O | R | O | O | O | O | O | O | O | N/A | N/A |
| **2.1 Industry-Centric Subsystem** | N/A | N/A | N/A | O | N/A | N/A | N/A | O | R | R | R | O | O | O | O | N/A |
| **2.2 Blended DoD-Industry Subsystem** | N/A | N/A | N/A | O | N/A | N/A | N/A | O | R | R | R | O | O | O | O | N/A |
| **2.3 DoD-Centric Subsystem** | N/A | N/A | N/A | O | N/A | N/A | R | O | R | R | R | O | O | O | O | N/A |
| **3.1 Industry-Centric Component** | N/A | N/A | N/A | O | N/A | N/A | N/A | O | N/A | N/A | N/A | R | N/A | N/A | O | N/A |
| **3.2 Blended DoD-Industry Component** | N/A | N/A | N/A | O | N/A | N/A | N/A | O | N/A | N/A | N/A | R | N/A | R | O | R |
| **3.3 DoD-Centric Component** | N/A | N/A | N/A | O | N/A | N/A | N/A | O | N/A | N/A | N/A | R | N/A | R | O | R |

| **Legend** |
|---|
| R = Required<br>O = Optional<br>N/A = Not Applicable |

*Table 7: Representative Example Rationales*

| Strategy | Satisfy Core and 50-50 Workload Requirements | Robust Government Infrastructure | Robust Industry Infrastructure | Significant Obsolescence & DMS/MS Issues | Common Subsystem Across Multiple Platforms | Inventory Investment Required But Inventory is Expensive, so Government Investment is Needed | Commonly Used Commercial Commodities |
|---|---|---|---|---|---|---|---|
| 1.1 Industry-Centric Platform | | | X | | | | |
| 1.2 Blended DoD-Industry Platform | X | X | X | X | | | |
| 1.3 DoD-Centric Platform | X | X | | X | | | |
| 2.1 Industry-Centric Subsystem | | | X | | X | | |
| 2.2 Blended DoD-Industry Subsystem | X | X | X | X | X | | |
| 2.3 DoD-Centric Subsystem | X | X | | X | X | | |
| 3.1 Industry-Centric Component | | | X | | | | X |
| 3.2 Blended DoD-Industry Component | | X | X | X | X | X | |
| 3.3 DoD-Centric Component | | X | | X | X | X | |

*Table 8: Product Support Roles*

| Strategy | Supply Base Management | Inventory Management | Maintenance & Repair | Technical Support | Systems Engineering | Information Systems | Configuration Management | Design Authority | Manpower & Personnel Management | Support Equipment Management | Facilities Management | CONUS Transportation & Distribution | OCONUS Transportation & Distribution | Contingency Area Transportation & Distribution | Training |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1.1 Industry-Centric Platform** | BV | BV | BV | BV | BV | BV | BV | BV | BV | BV | BV | BV | BV | G | BV |
| **1.2 Blended DoD-Industry Platform** | BV | BV | BV | BV | BV | BV | BV | BV | BV | BV | BV | BV | BV | G | BV |
| **1.3 DoD-Centric Platform** | G | G | G | G | G | BV | G | G | G | G | G | BV | BV | G | G |
| **2.1 Industry-Centric Subsystem** | BV | BV | BV | BV | BV | BV | BV | BV | BV | BV | BV | BV | BV | G | BV |
| **2.2 Blended DoD-Industry Subsystem** | BV | BV | BV | BV | BV | BV | BV | G | BV | BV | BV | BV | BV | G | BV |
| **2.3 DoD-Centric Subsystem** | G | G | G | G | G | BV | G | G | G | G | G | BV | BV | G | G |
| **3.1 Industry-Centric Component** | BV | BV | BV | BV | BV | BV | BV | G | BV | BV | BV | BV | BV | G | BV |
| **3.2 Blended DoD-Industry Component** | BV | BV | BV | BV | BV | BV | BV | G | BV | BV | BV | BV | BV | G | BV |
| **3.3 DoD-Centric Component** | G | G | G | G | G | BV | G | G | G | G | G | BV | BV | G | G |

| **Legend** |
|---|
| G = Government Responsibility<br>BV = Best Value |

*Table 9: Government and Industry Incentives*

| Strategy | Government | Industry |
|---|---|---|
| **1.1 Industry-Centric Platform** | • Ties remuneration to outcomes Incentivizes increased reliability<br>• Guarantees all service levels<br>• Enhanced tie between acquisition and sustainment | • Opportunity to invest current profit to reduce cost for increased future profit<br>• Opportunity to leverage technical expertise to improve support at reduced cost<br>• Build long-term business relationship with customer |
| **1.2 Blended DoD-Industry Platform** | • Uses and develops core capabilities<br>• Satisfies 50-50 workload<br>• Reduces unnecessary excess Government capacity<br>• Guarantees some service levels<br>• Enhanced tie between acquisition and sustainment | • Opportunity to invest current profit to reduce cost for increased future profit<br>• Opportunity to leverage technical expertise to improve support at reduced cost<br>• Build long-term business relationship with customer |
| **1.3 DoD-Centric Platform** | • Uses and accelerates development of core capabilities<br>• Satisfies 50-50 workload Reduces unnecessary excess Government capacity<br>• Full funding control<br>• Authorized to invest in improvements<br>• Able to share savings or award incentives with organic and industry providers | • Transactional revenue from product support |
| **2.1 Industry-Centric Subsystem** | • Ties Remuneration to outcomes<br>• Incentivizes Increased reliability<br>• Guarantees contracted subsystem service levels<br>• Enhanced tie between acquisition and sustainment | • Opportunity to invest current profit to reduce cost for increased future profit<br>• Opportunity to leverage technical expertise to improve support at reduced cost<br>• Build long-term business relationship with customer |
| **2.2 Blended DoD-Industry Subsystem** | • Uses and develops core capabilities<br>• Satisfies 50-50 workload<br>• Reduces unnecessary excess Government capacity<br>• Guarantees some service levels<br>• Enhanced tie between acquisition and sustainment | • Opportunity to invest current profit to reduce cost for increased future profit<br>• Opportunity to leverage technical expertise to improve support at reduced cost<br>• Build long-term business relationship with customer |

| Strategy | Government | Industry |
|---|---|---|
| **2.3 DoD-Centric Subsystem** | • Uses and accelerates development of core capabilities<br>• Satisfies 50-50 workload<br>• Reduces unnecessary excess Government capacity<br>• Full funding control<br>• Authorized to invest in improvements<br>• Able to share savings or award incentives with organic and industry providers | • Transactional revenue from product support |
| **3.1 Industry-Centric Component** | • Competitive sourcing reduces cost<br>• Increases opportunity for Vendor Managed Inventory and Just-In-Time strategies<br>• Guarantees all service levels<br>• Enhanced tie between acquisition and sustainment | • Revenue from product support |
| **3.2 Blended DoD-Industry Component** | • Enables guarantee of service levels<br>• Increases opportunity for reduced inventory levels<br>• Allows flexibility in vendor selection<br>• Enhanced tie between acquisition and sustainment | • Revenue from product support<br>• Reduced required Industry overhead<br>• Increased workload for amortizing physical and HR overhead |
| **3.3 DoD-Centric Component** | • Reduced cost recovery rate | • Transactional revenue from product support |

*Table 10: Product Support Responsibility*

| Strategy | Outcomes For Which PSIs Are Responsible |
|---|---|
| **1.1 Industry-Centric Platform** | • System sustainment, performance, and cost outcomes as specified in the Performance Based Agreements<br>• Working directly with, monitoring, and evaluating the Industry product support provider |
| **1.2 Blended DoD-Industry Platform** | • System sustainment, performance, and cost outcomes as specified in the Performance Based Agreements<br>• Working through, monitoring, and evaluating a single Government or Industry product support provider<br>• Enterprise and capability integration using one or more Government and Industry product support providers |
| **1.3 DoD-Centric Platform** | • System sustainment, performance, and cost outcomes as specified in the Performance Based Agreements<br>• Working directly with the Government product support provider |
| **2.1 Industry-Centric Subsystem** | • System sustainment, performance, and cost outcomes as specified in the Performance Based Agreements<br>• Working with, monitoring, and evaluating multiple Industry and any number of, including zero, Government subsystem product support providers<br>• Enterprise and capability integration using one or more Government and Industry product support providers |
| **2.2 Blended DoD-Industry Subsystem** | • System sustainment, performance, and cost outcomes as specified in the Performance Based Agreements<br>• Working with, monitoring, and evaluating multiple Industry and Government subsystem product support providers<br>• Enterprise and capability integration using one or more Government and Industry product support providers |
| **2.3 DoD-Centric Subsystem** | • System sustainment, performance, and cost outcomes as specified in the Performance Based Agreements<br>• Working with, monitoring, and evaluating multiple Government and any number of, including zero, Industry subsystem product support providers<br>• Enterprise and capability integration using one or more Government and Industry product support providers |
| **3.1 Industry-Centric Component** | • Overall system performance to an agreed on outcomes and cost<br>• Working with, monitoring, and evaluating multiple Industry and any number of, including zero, Government component providers<br>• Enterprise and capability integration using one or more Government and Industry product support providers |

| Strategy | Outcomes For Which PSIs Are Responsible |
|---|---|
| **3.2 Blended DoD-Industry Component** | • Overall system performance to an agreed on outcomes and cost<br>• Working with, monitoring, and evaluating multiple Industry and Government component providers<br>• Enterprise and capability integration using one or more Government and Industry product support providers |
| **3.3 DoD-Centric Component** | • Overall system performance to an agreed on outcomes and cost<br>• Working with, monitoring, and evaluating multiple Government and any number of, including zero, Industry component providers<br>• Enterprise and capability integration using one or more Government and Industry product support providers |

*Table 11: Analytic Tools Approach*

| Strategy | Probable Periodically Used Analytic Tools |
|---|---|
| **1.1 Industry-Centric Platform** | • Business Case Analysis<br>• Equal or better value proposition |
| **1.2 Blended DoD-Industry Platform** | • Business Case Analysis<br>• Equal or better value proposition |
| **1.3 DoD-Centric Platform** | • Periodic In-Service Reviews<br>• Best Value Analysis where possible change to the product support strategy is indicated |
| **2.1 Industry-Centric Subsystem** | • Business Case Analysis<br>• Equal or better value proposition |
| **2.2 Blended DoD-Industry Subsystem** | • Business Case Analysis<br>• Equal or better value proposition |
| **2.3 DoD-Centric Subsystem** | • Periodic In-Service Reviews<br>• Best Value Analysis where possible change to the product support strategy is indicated |
| **3.1 Industry-Centric Component** | • Business Case Analysis<br>• Equal or better value proposition |
| **3.2 Blended DoD-Industry Component** | • Business Case Analysis<br>• Equal or better value proposition |
| **3.3 DoD-Centric Component** | • Periodic In-Service Reviews<br>• Best Value Analysis where possible change to the product support strategy is indicated |

# Appendix D: Product Support Cost Estimation Methodology

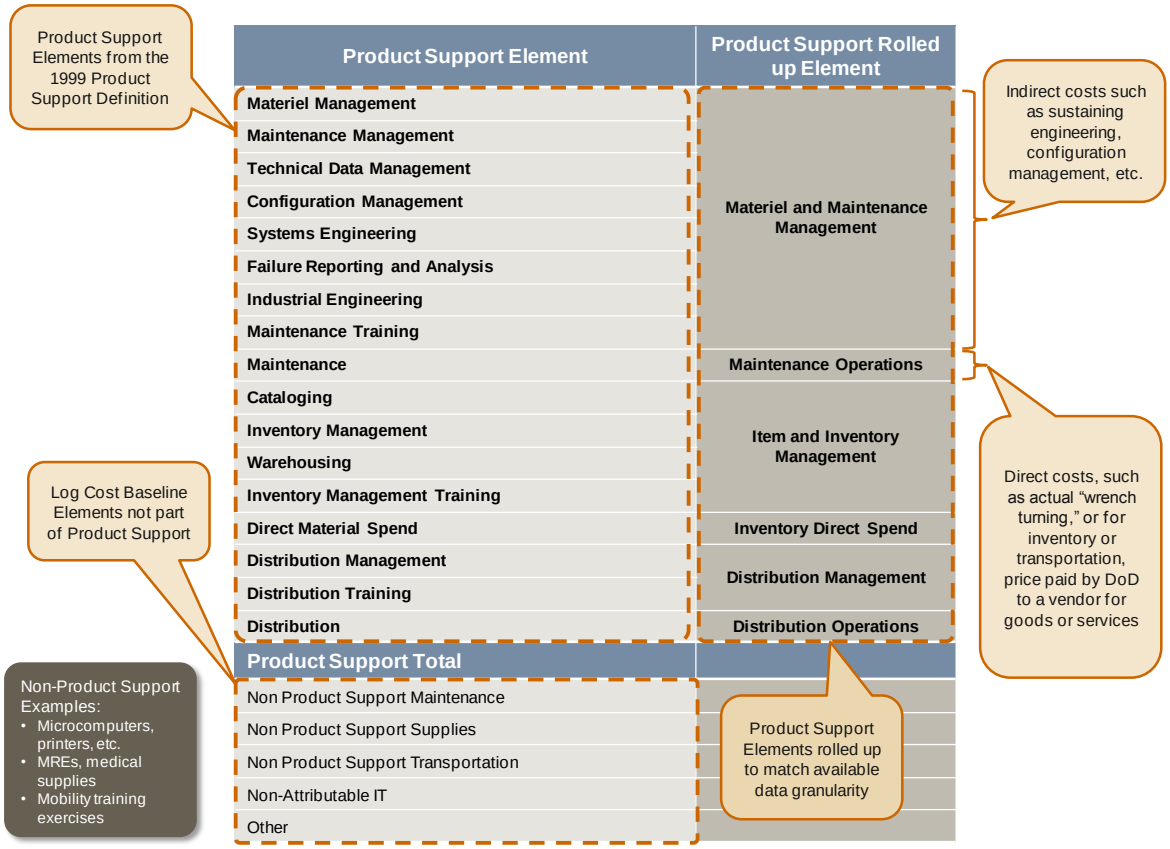
This appendix explains how the cost of product support was calculated using Logistics Cost Baseline data. **Note that this cost is from the Operations & Maintenance (O&M) and Military Personnel (MilPers) budget requests only and does not include costs resident in the Procurement or Research, Development, Test & Evaluation (RDT&E) budget requests.** This means that the total product support cost identified later in this appendix should be thought of as at least $132 billion.

This appendix is intended to enable analysts to estimate the cost for weapon system product support in future years and assumes the reader has some familiarity with the President's Budget Request budget exhibits, though does not require that the reader have expert knowledge. Due to the non-granular nature of the exhibits used to estimate this cost, this estimate should be refined in future calculations as higher fidelity information is made available to DoD analysts. The principal opportunity for improvement is discussed later in this appendix.

## Elements of Product Support

Product support cost is a subset of the Logistics Cost Baseline, which is calculated by the DUSD (L&MR). Accordingly, the product support cost estimate consists of a selection of logistics cost baseline elements. The elements that comprise product support are summarized in Figure 39. Due to the high-level nature of the data provided by the Services' comptrollers, product support elements must be summarized or "rolled up" to enable categorization of OP-32 line items into product support categories.

*Figure 39: Product Support Cost Framework*




## Product Support Cost Estimation Data

Product support cost estimation requires a variety of data sources and assumptions, which are described in Table 12.

DUSD (L&MR) analysis depends on OP-32 line items provided by the Services' comptrollers, on personnel cost estimates extracted from the O&M (for civilian personnel) and MilPers DoD President's Budget Requests, and on estimates of logistics workforce composition provided by Logistics Management Institute (LMI).

Note that the OP-32 line items the DUSD (L&MR) receives are summed from all of the OP-32 line items provided by the Services in their budget requests. Better estimates of the Logistics Cost Baseline and product support costs will be achievable when OP-32 line items are provided in an analyzable format such as MS Excel and are detailed by Subactivity Group (SAG) and Service O&M budget request. This will allow better categorization of costs identified in OP-32 line items to various logistics categories since the logistics composition of SAGs varies.

Additionally, Service and Agency working capital fund budget documentation provides cost recovery rates or similar percentages used to estimate management versus direct product support costs.

Finally, 88 percent of each OP-32 line item is assumed to be product support when no better data exists, with the remaining 12 percent considered to be non-product support logistics.

***Table 12: Product Support Cost Estimation Assumptions, Data Points, and Sources***

| Data Point or Assumption | Source or Logic |
|---|---|
| OP-32 Line Items | OSD (Comptroller) |
| Log Cost Baseline Summary | OADUSD SCI |
| Army Actual FY 2008 Cost Recovery Rate | Army Working Capital Fund FY 2010 Budget Estimates |
| Navy Actual FY 2008 Cost Recovery Rate | Navy Working Capital Fund FY 2010 Budget Estimates |
| USMC Actual FY 2008 Cost Recovery Rate | Navy Working Capital Fund FY 2010 Budget Estimates |
| USAF Actual FY 2008 Cost Recovery Rate | USAF Working Capital Fund FY 2010 Budget Estimates: CRR = FY 2008 Consolidated Sustainment Activity Group (CSAG) Business Overhead Expenses ($1,305.516M) / Revised Net Sales @ Cost ($3,864.960M) |
| GSA Cost Recovery Rate | U.S. General Services Administration Summary of Rates and Fees, FY 2009 |
| DLA Cost Recovery Rate | Defense-Wide Fiscal Year FY 2010 Budget Estimates |
| Defense Energy CRR = DLA CRR | Similar Skill Sets and Management Infrastructure Required for Both Agencies; Offices Are Collocated |
| Credit Card Merchant Fee of 1.5% for Locally Procured Fund Managed Supplies and Materials | Typical Merchant Fee |
| TWCF Cost Recovery Rate | Air Force Working Capital Fund FY 2010 Budget Estimates with Equation Equal to: 1 - (Cost to Transport Things / Total TCF Cost) |
| Assumed Percent of Logistics That Is Product Support When No Better Data Exists = 88% | Product Support for the 21st Century – July 1999 |

## Product Support Cost Calculation Methodology

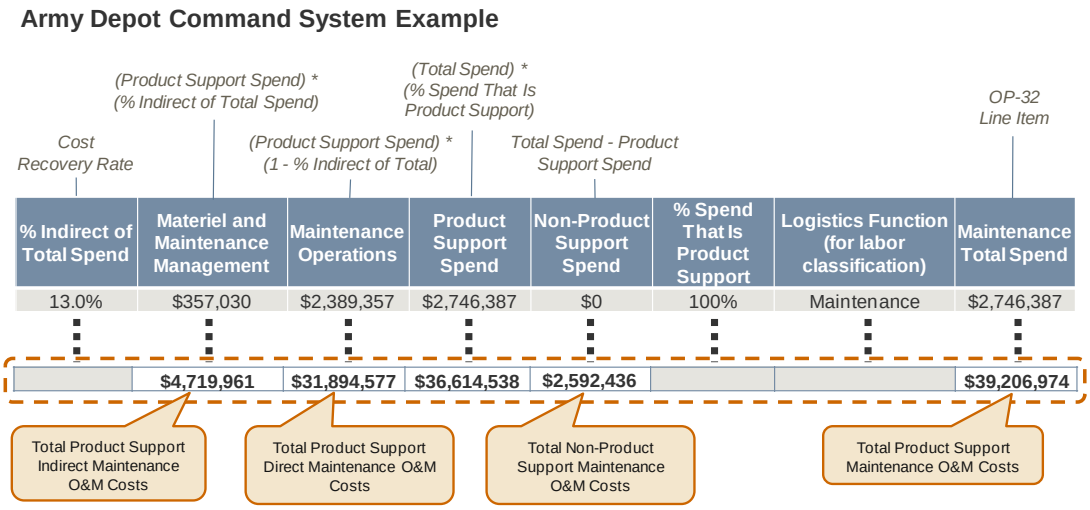
The product support cost estimation method is explained using maintenance operations and maintenance management as examples and applies equally to all product support rolled-up elements and non-product support elements.

Each OP-32 line item in the Logistics Cost Baseline is decomposed and categorized into the product support rolled-up elements or non-product support elements of Figure 39. The mechanics of this decomposition are shown in Figure 40.

The OP-32 line item called “Army Depot Command System” is categorized at a high level as a maintenance operations and maintenance management product support rolled-up element, of which 100 percent is considered product support. The Army Working Capital Fund uses a cost recovery rate of 13 percent. This cost recovery rate is the percent of working capital inflow intended to fund the management tasks and other activities needed to run maintenance operations and is used to estimate overhead costs within the Army Depot Command System.

The bottom line of Figure 39, “Other,” represents the combined costs of all OP-32 line items categorized as maintenance and maintenance operations and provides the non-labor O&M cost associated with the maintenance operations and maintenance management rolled-up product support elements.

***Figure 40: OP-32 Line Items Are Decomposed and Categorized to Build Total Product Support Costs***




Having estimated the O&M cost for maintenance operations and maintenance management, the next costs calculated are labor. Figure 41 shows these labor cost calculations and also shows how the total maintenance operations cost is calculated. To summarize, each rolled-up product support element is comprised of OP-32 line items that are assigned one of three labor category labels: maintenance, supply, and transportation. These labels are from LMI's logistics workforce composition estimates and resemble but are not equivalent to the product support elements of Figure 38. Because there are some OP-32 line items that belong in one product support rolled-up element but have different labor category labels associated with them, each rolled-up element has some percentage of its cost ascribed to each label.

In the example shown in Figure 41, Maintenance Operations has 45 percent of the total O&M spend associated with the Maintenance Labor category label, 13 percent of the Supply, and none of the Transportation. The civilian labor cost for Maintenance Operations is 45 percent of $11 billion plus 13 percent of $7 billion plus 0 percent of $1 billion equal to about $6 billion. A similar calculation is shown below for military labor. The Maintenance Operations O&M plus civilian labor plus military labor equals about $53 billion.

*Figure 41: Maintenance Operations Rolled-up Element Cost Calculation Example*

**Maintenance Operations Example**

| | O&M Distribution across Product Support Rolled up Elements | | |
|---|---|---|---|
| | Maintenance | Supply | Transportation |
| Materiel and Maintenance Management | 8.5% | 0.2% | 0% |
| Maintenance Operations | 45% | 13% | 0% |

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| Personnel Spend | | |
|---|---|---|
| | MilPers | CivPers |
| Maintenance | $30,259,900 | $11,069,021 |
| Supply | $11,695,915 | $6,715,729 |
| Transportation | $4,196,963 | $1,014,180 |

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| MilPers and CivPers Spend by Product Support Rolled up Element |
|---|
| Materiel and Maintenance Management |
| Maintenance Operations |

**Example Calculation**

Maint Ops O&M
Maint Ops Maintenance * (MilPers Maint + CivPers Maint)
Maint Ops Supply * (MilPers Supply + CivPers Supply)
\+ Maint Ops Transp * (MilPers Transp + CivPers Transp)

$32B
45% * ($30B + $11B)
13% * ($12B + $7B)
\+ 0% * ($4B + $1B)

**Total Maintenance Operations Cost: $53B**

## Product Support Cost Calculation Results

The results of all of the cost calculations are shown in Figure 42. The two critical numbers to note on this slide are that the Logistics Cost Baseline is about $190 billion and that the total product support cost is $132 billion. This means that product support is about $132/$190 ≈ 70 percent of total logistics cost.

## *Figure 42: Product Support Cost Calculation Results*

| Product Support Element | Product Support Rolled up Element | O&M ($K) | MilPers ($K) | Civ Pers ($K) | Total ($K) |
|---|---|---|---|---|---|
| **Materiel Management** | **Materiel and Maintenance Management** | $4,719,961 | $2,586,614 | $951,081 | **$8,257,656** |
| **Maintenance Management** | | | | | |
| **Technical Data Management** | | | | | |
| **Configuration Management** | | | | | |
| **Systems Engineering** | | | | | |
| **Failure Reporting and Analysis** | | | | | |
| **Industrial Engineering** | | | | | |
| **Maintenance Training** | | | | | |
| **Maintenance** | **Maintenance Operations** | $31,894,577 | $15,218,084 | $5,888,667 | **$53,001,328** |
| **Cataloging** | **Item and Inventory Management** | $6,418,812 | $1,356,672 | $778,988 | **$8,554,471** |
| **Inventory Management** | | | | | |
| **Warehousing** | | | | | |
| **Inventory Management Training** | | | | | |
| **Direct Material Spend** | **Inventory Direct Spend** | $33,957,404 | $7,177,106 | $4,121,054 | **$45,255,564** |
| **Distribution Management** | **Distribution Management** | $4,658,872 | $1,362,499 | $329,243 | **$6,350,614** |
| **Distribution Training** | | | | | |
| **Distribution** | **Distribution Operations** | $7,969,933 | $2,330,828 | $563,236 | **$10,863,997** |
| **Product Support Total** | | **$89,619,558** | **$30,031,803** | **$12,632,268** | **$132,283,630** |
| Non Product Support Maintenance | | $2,592,436 | $1,092,909 | $444,351 | **$4,129,696** |
| Non Product Support Supplies | | $3,978,462 | $840,875 | $482,825 | **$5,302,161** |
| Non Product Support Transportation | | $1,722,110 | $503,636 | $121,702 | **$2,347,447** |
| Non-Attributable IT | | $1,240,201 | $689,733 | $252,303 | **$2,182,237** |
| Other | | $24,945,589 | $12,993,823 | $4,865,481 | **$42,804,893** |
| **Logistics Cost Baseline Total** | | **$124,098,356** | **$46,152,778** | **$18,798,930** | **$189,050,064** |