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HIMARS: A High Performance PBL

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The Center for Public Policy and Private Enterprise at the University of Maryland's School of Public Policy provides the strategic linkage between the public and private sector to develop and improve solutions to increasingly complex problems associated with the delivery of public services—a responsibility increasingly shared by both sectors. Operating at the nexus of public and private interests, the Center researches, develops, and promotes best practices; develops policy recommendations; and strives to impact senior decision-makers toward improved government and industry results.

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Executive Summary

The High Mobility Artillery Rocket System (HIMARS) is a wheeled, agile, rocket and guided missile launcher for which logistics and sustainment are provided through a public-private partnership (PPP) between the U.S. Army and Lockheed Martin. The HIMARS program relies on a performance-based logistics (PBL) strategy that ensures the cost-effective delivery of specified performance outcomes. Since its inception the HIMARS PBL has consistently met or exceeded cost and performance objectives, having twice received the Secretary of Defense Performance-Based Logistics Award, which recognizes government and industry teams that provide warfighters with superior operational capability.

Given current and anticipated budgetary constraints, the DoD must heighten its focus on affordability. At the same time, new threats demand superior technology that is highly-reliable. To a large extent, these twin objectives—reduced costs and better performance—can be achieved through the wider implementation of the PBL approach. Unfortunately, however, PBL contracting is not being aggressively pursued across the DoD.

In most cases, PBL contracts are multi-year agreements (typically 5-15 years, plus options) according to which the chosen contractor manages a given system's supply chain. These long-term partnerships with industry often leverage commercial best practices in the key performance areas of availability, reliability, logistics footprint, and cost. The HIMARS exemplifies the attributes of a successful PBL program. It is therefore instructive to examine the program's history, structure, and specific features in order that future weapon systems programs might benefit by adopting a similar approach.

The HIMARS vehicle comprises a launcher pod of six rockets that are loaded onto the bed of the vehicle. The front of the system is fitted with a fully enclosed and armored cab, which provides protection against small arms fire. The HIMARS can be loaded onto

cargo jets, including the C-130, and thus can be deployed to areas that were previously inaccessible to heavier launchers.

Per the program's performance-based agreement, the HIMARS PBL program measures performance in the following areas: system status readiness; average response time for critical non-mission-capable launcher failures in the continental United States and outside the continental United States; average repair time in the field; and average depot repair turnaround time (DoD, 2006). Note the relative simplicity of these requirements, which facilitated straightforward monitoring and, thus, complete transparency.

The Army awarded the first HIMARS PBL contract to Lockheed Martin in the amount of $96 million in February 2004 (Lockheed Martin, 2004). The four-year contract, referred to as Life Cycle Contractor Support (LCCS) ended in December 2007. Given its increasing inventory of HIMARS, the existence of a successful partnership between the Army and Lockheed Martin, and the cost benefits that derive from economies of scale, the Marines sought to support its launchers through LCCS upon completion of the initial contract. Accordingly, the second contract (LCCS II), a three-year contract worth $90 million, was awarded in January 2008 to support both the Army and Marines' systems.

By 2011, Lockheed Martin was supporting 620 Army and Marines fielded mobile launcher systems—396 HIMARS and 224 MLRS M270A1—via "firm-fixed price with incentive fee" contracts for stateside operations and "cost-plus fixed fee" contracts for overseas contingency operations (Gardener, 2008). A third contract, in the amount of $158 million, termed Life Cycle Launcher Support (LCLS), extended HIMARS sustainment through December 2013 for services, and through December 2014 for hardware.

The LCCS/LCLS program is headquartered in Dallas, where numerous program functions are executed, including program management, depot repair coordination, inventory control, contracting with suppliers, design interface, and database maintenance

(Lockheed Martin, 2013). The database tracks the location of each launcher, including each spare part, indicated whether the part is functional, and provides its status with regard to the repair process.

There are also 26 field service representatives (FSRs) that operate from 22 locations, eight of which are overseas. In-theater maintenance work is performed by soldiers, with the assistance of these FSRs (Hawkins, 2009). Given the level of sophistication provided by Lockheed Martin's database and logistics networks, the FSRs are able to streamline and simplify the repair process for launchers. In fact, soldiers operating the system in theater need only remove and replace defective components. Perhaps one of the greatest benefits is the provision of limited depot-level repair capability at each battalion, where repair work is provided by the FSR. Referred to as the capability to "Fix Forward," some 50% of HIMARS repairs are performed on location by the FSRs, eliminating wait times and significantly reducing costs. This in-the-field repair capability has also significantly improved deployed launcher availability.

Over the course of the last decade, The HIMARS PBL has repeatedly achieved and exceeded the performance requirements. Success was achieved early on. In submitting its list of critical accomplishments for consideration by the DoD Awards Program in Performance-Based Logistics in 2006, the HIMARs Program Office noted that Lockheed Martin earned the maximum incentive fee each quarter for having achieved 99% plus system readiness for every contract quarter (DoD, 2006).

Lockheed Martin's LCCS program has also initiated a robust obsolescence management strategy early on in order to ensure that it could meet performance requirements (DoD, 2006). The LCCS program regularly monitors the Government-Industry Data Exchange Program in order to identify potential obsolescence issues. Within the first couple of years of the PBL, LCCS team recognized the potential for the obsolescence of numerous components, identified alternate parts, and supported specific redesign efforts (DoD, 2006). Although a natural extension of the PBL strategy, obsolescence management has proven challenging under other contracting or in-house arrangements.

The LCCS II contract required that system readiness be maintained at or above 90% and that response time be below 48, 72, or 96 hours for U.S. based operations, depending on the nature of the problem, 92%, 91%, and 90% of the time, respectively (DoD, 2009). For overseas operations, the response time had to be below 96, 120, or 144 hours (DoD, 2009). The program consistently achieved these objectives at the required percentages in all performance areas. As a result, the LCCS team won its second Secretary of Defense Performance-Based Logistics Award in 2009.

In addition, the program also tracks reliability, monitoring the mean time between system aborts (MTBSA) and mean time between essential function failure (MTBEFF). The HIMARS program's reliability far exceeds the Army's required performance goals.

The HIMARS experience makes it clear that when properly implemented, PBL strategies can result in reduced costs and continuously-improving performance. The HIMARS PBL strategy worked to ensure that incentives were carefully structured and aligned with the performance requirements of the system. With the incentives aligned, integration between the provider and customer was readily achieved. The support provider, appropriately empowered, was able to work to improve logistics efficiency, improve performance, reduce costs, and make reliability improvements that reduce life cycle costs; resulting in a win-win for both customer and provider.

We have identified a number of the HIMARS program's attributes which we believe can inform future PBL programs, thereby helping to ensure their success:

Alignment of contractor incentives with performance requirements.

It is critical that the PBL incentives be carefully structured and aligned with the performance requirements of the system. With the incentives aligned, integration between the provider and customer is generally improved.

Clearly-defined performance metrics

Performance metrics, rooted in a performance-based agreement, provides a clear and objective way to measure the progress of the support provider.

A total life-cycle systems management perspective

A life-cycle based perspective will improve reliability and maintainability, and better manage costs.

Supply chain management

Material support is a critical link in the supportability of weapon systems. The best skilled labor, advanced technology, and performance mean little without the "right part, at the right place, at the right time."

Public-Private Partnerships

It is essential to achieve the right public-private mix for each program, with clearly defined and measurable expectations. In addition to satisfying the statutory requirements, using the strengths of the organic and contractor organizations can provide a better logistics solution.

Operational requirements and funding pressures are driving the need for logistics transformation. PBLs often require government organizations to shift their focus and to perform tasks that are different from their traditional tasks. Needless-to-say, a successful logistics transformation will require a sustained leadership commitment to change the existing culture and have it embrace the new organizational role required for successful PBL implementation.

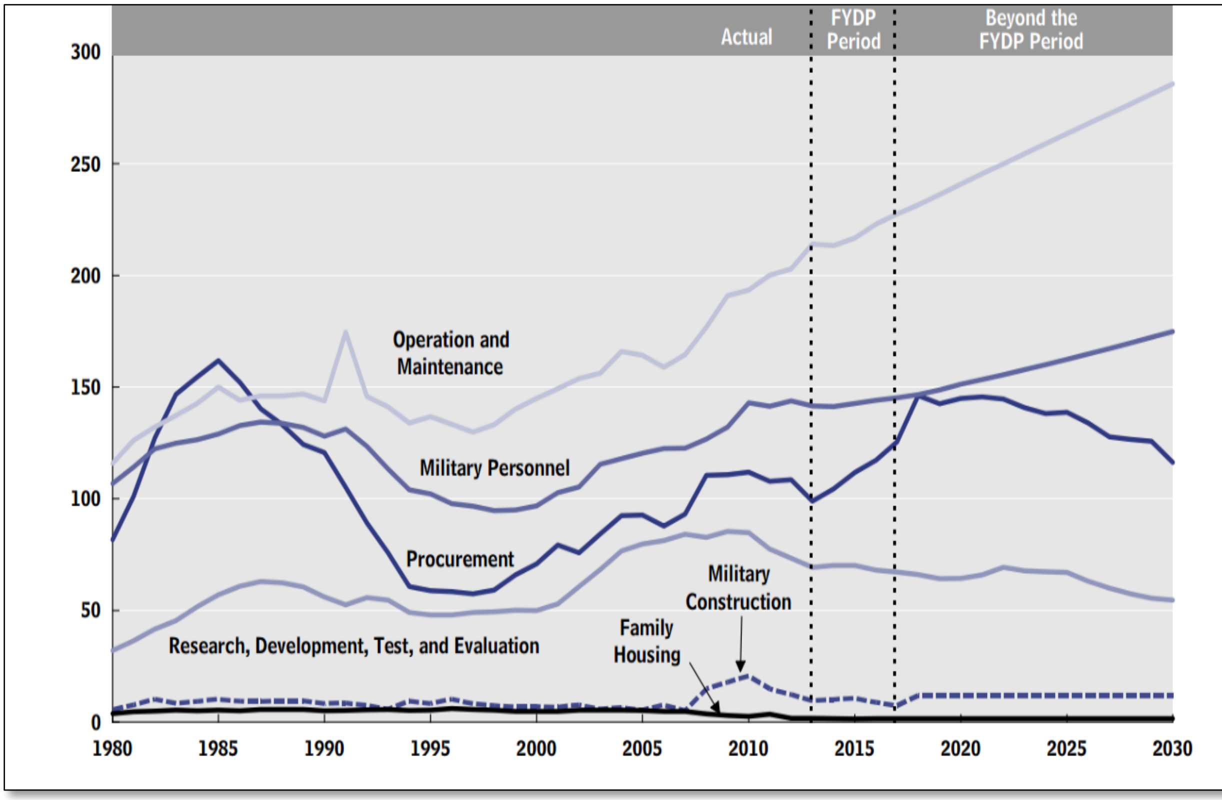
I. Introduction

The High Mobility Artillery Rocket System (HIMARS) is a wheeled, agile, rocket and guided missile launcher for which logistics and sustainment are provided through a public-private partnership (PPP) between the U.S. Army and Lockheed Martin. The HIMARS product support relies on a performance-based logistics (PBL) strategy that ensures the cost-effective delivery of specified performance outcomes. Under this arrangement, Lockheed Martin provides the fire control system, the launcher loader modules, and full system support. This program has demonstrated how an appropriately structured PBL contract can increase system performance, while reducing sustainment costs.

Since its inception, the HIMARS PBL has consistently met or exceeded cost and performance objectives, having twice received the Secretary of Defense Performance-Based Logistics Award, which recognizes government and industry teams that provide warfighters with superior operational capability. In fact, HIMARS is the only two-time recipient of this award. The HIMARS, supported by this PBL contract, has also proven itself on the battlefield, playing an integral role in Operation Iraqi Freedom and other overseas contingency operations.

Unfortunately, however, PBL contracting is not being aggressively pursued across the DoD. Meanwhile, operations and maintenance (O&M) costs are a leading driver of the DoD's budgetary challenges (see Figure 1). In fact, the average total cost of O&M per troop nearly doubled to $115,000 in 2012, compared with $58,000 in 2001 (Korb, Rothman, & Hoffman, 2012). What is more, these costs are increasing against a backdrop of shrinking defense budgets.

At the national level, the U.S. deficit is projected to exceed the nation's GDP by the early 2020s (Congressional Budget Office, 2013). In fact, it is projected that mandatory federal spending (on healthcare, social security, income security programs, federal and military retirement benefits, and veterans' benefits) and interest payments will exhaust the entire federal budget by 2036 if current trends in spending and demographics continue (Center



for Strategic and International Studies, 2013).

Figure 1. The DoD's costs (2013 billions of dollars) by appropriation category (CBO, 2013)

The fact that total defense spending (in real terms) was higher in 2010 than at any point since the end of World War II suggests to critics that the military could further decrease the number of troops and reduce the scope of acquisitions. At present, however, with the projected cuts, the active military force structure will be at near post-Cold War lows (see Figure 2), and existing equipment inventories are becoming older, smaller, and less effective against emerging technologies.

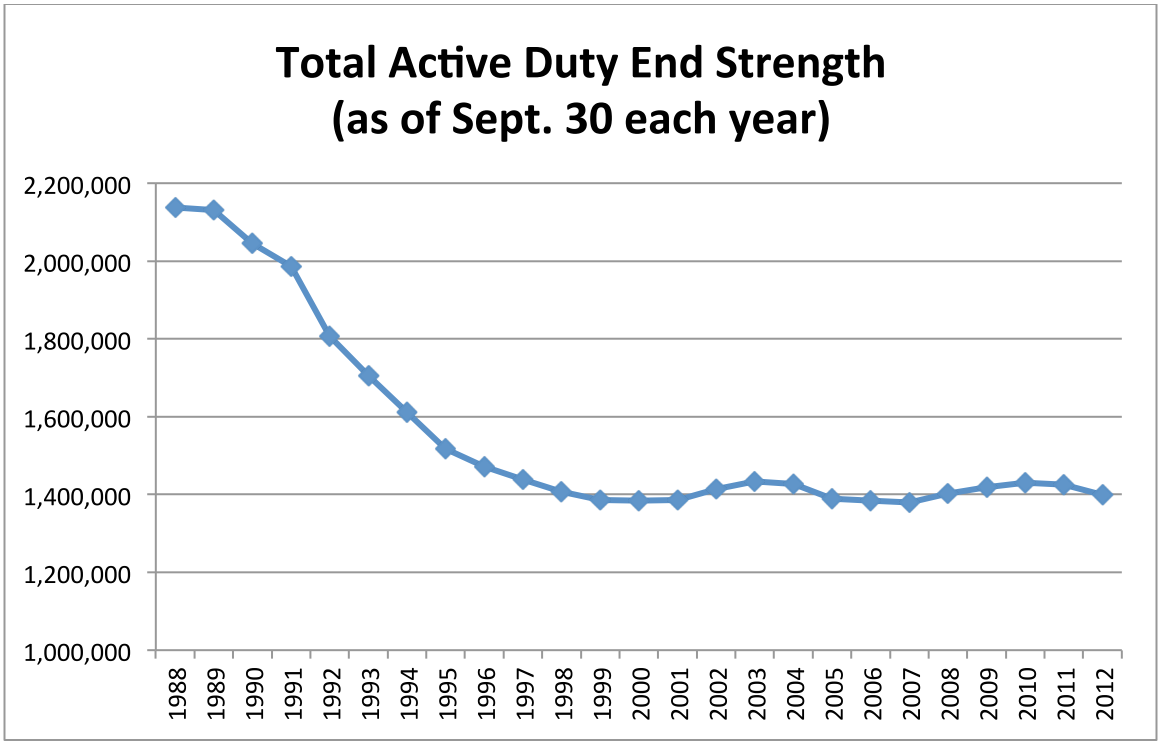


Figure 2. Total active duty military end strength (1988-2012)
Note. The information in this graph came from CSIS, 2013.

It is within this challenging environment that the DoD must seek to reduce its operations and maintenance costs, which will increase to close to $200 billion by 2015 (DoD, 2014; see Figure 3). Weapons sustainment is a significant driver of these costs. For instance, the DoD will request over $14 billion to fund depot maintenance in FY 2015, which is $986 million (7%) more than the amount spent in the previous year (DoD, 2014). Properly-implemented PBL strategies have the potential to reduce these and other sustainment-related costs.

Given current and anticipated budgetary constraints, the DoD must heighten its focus on affordability. At the same time, new threats (e.g. cyber-espionage, a rising China, and a chaotic Middle East) demand superior technology that is highly-reliable. To a large extent, these twin objectives—reduced costs and better performance—can be achieved through the wider implementation of the PBL approach. Such was the case with the HIMARS program.

$ in Thousands **Base Budget**	**FY 2014 Enacted**	**FY 2015 Request**	**Delta FY14 - FY15**
Military Personnel	135,924,801	135,193,685	-731,116
Operation and Maintenance	192,822,692	198,726,096	5,903,404
Procurement	92,439,558	90,358,540	-2,081,018
RDT&E	62,805,956	63,533,947	727,991
Revolving and Management Funds	2,222,427	1,234,468	-987,959
Defense Bill	**486,215,434**	**489,046,736**	**2,831,302**
Military Construction	8,392,244	5,366,912	-3,025,332
Family Housing	1,415,764	1,190,535	-225,229
Military Construction Bill	**9,808,008**	**6,557,447**	-3,250,561
Total	**496,023,442**	**495,604,183**	**-419,259**

Note: Reflects Discretionary Budget Authority, FY 2014 includes $4,205938 in prior year rescissions

Numbers may not add due to rounding

Figure 3. DoD base budget by appropriation title (DoD, 2014)

PBL programs are designed to increase weapon system readiness at lower costs relative to traditional sustainment strategies. Given the success of the HIMARS, it is instructive to examine the program's history, structure, and specific features in order that future weapon systems programs might benefit by adopting a similar approach.

II. The HIMARS System

HIMARS was designed to meet the requirement for a lighter, more deployable, mobile rocket launcher that can be sent virtually anywhere in order to provide lethal, long-range fires. HIMARS was specifically designed to support the Army's Entry Contingency forces and its Light/Airborne/Air Assault Divisions with long-range, general support, rocket and missile indirect fires ("XM142," 2008).

A Brief History

Modern mobile rocketry systems have a history dating back to World War II. In the 1930s and 40s, Russia and Germany developed simple launchers designed for mobility and a wide range, marking a shift away from traditional "tube" artillery. The Germans first developed simple launchers using inspiration from the *Nebelwerfer*, or smoke projector. The Russians furthered the concept by mounting it on the back of trucks (Dugdale-Pointon, 2002). The Russians then continued to develop this cheap and effective system, referred to as the General Support Rocket System (GSRS) weapon, for client states. The first, and most famous of these self-propelled multiple rocket systems, was nicknamed the *Katyushas*. Following its success in World War II, the GSRS was used in several conflicts, including Vietnam and Korea (Dugdale-Pointon, 2002).

BM-13N *Katyusha* on a Studebaker US6 truck

In the 1980s, western countries, including the United States, further adapted the system. The U.S. relied on an upgraded version of the GSRS in 1983 during the Gulf War. Whereas the *Katyushas* consisted of a rack of launch rails mounted to the back of a truck, the American system used advanced targeting and GPS systems, allowing "targets to be engaged without multiple aiming points" ("MLRS", 2014, p. 1). Still, the system had shortcomings; accuracy and range were limited. Thus, its use was restricted to targets in open terrain where collateral damage could be contained. Its range—31.5 kilometers—would soon be surpassed by many foreign multiple-rocket launchers (MRLs; "MLRS", 2014).

After upgrading launcher responsiveness and enhancing the range and precision, the GSRS was reintroduced during Operation Desert Storm in 1991 under a new name, the Multiple Launcher Rocket System (MLRS). The improved MLRS was designed to fire more warheads at a faster pace and a further distance ("MLRS", 2014). Its deployment in Operation Desert Storm was to be the new system's first field test. The first combat launch consisted of ten armored vehicles firing more than 100 rockets in a minute (Lockheed Martin, n.d.). The system's accuracy and power compelled Iraqi troops to remain in their bunkers, allowing U.S. forces to capture enemy positions.

The MLRS deployed in Desert Storm

While the MLRS performed well during Operation Desert Storm, its rockets and submunitions raised concerns. Many of the Iraqi artillery still outranged the American rockets and the MLRS submunitions' high dud rate led to questions over the safety of soldiers and noncombatants ("MLRS", 2014). In an attempt to address these issues, the HIMARS was developed to complement the existing MLRS family of mobile rocket systems.

System Description

The HIMARS is a highly-mobile weapons platform that provides lethal, long-range firing capability. It is a 24-hour, all-weather system that can aim at a target in 16 seconds (Lockheed Martin, 2008). This wheeled, agile rocket and guided missile system is a lighter, transportable version of the legacy M-270 MLRS, described previously.

The M142 HIMARS

The HIMARS vehicle comprises a launcher pod of six rockets that are loaded onto the bed of the vehicle. The front of the system is fitted with a fully enclosed and armored cab, which provides protection against small arms fire. The HIMARS can be loaded onto cargo jets, including the C-130, and thus can be deployed to areas that were previously inaccessible to heavier launchers (Hamilton, 2011). It is highly transportable, owing to its wheeled chassis and lighter weight. The 6-pack of rockets in the HIMARS weights about 24,000 pounds, which is lighter than the MLRS's 12 rockets, which weigh in at 44,000 pounds (Baker, 2003).

The HIMARS fire control system has video, keyboard control, one gigabyte of program storage and a global positioning system ("HIMARS", 2014). In addition, the system incorporates self-loading, autonomous features and is capable of firing either six MLRS series rockets or one Army Tactical Missile System (ATACMS) missile. The HIMARS fire control system, electronics, and communications units are all interchangeable with the existing M270A1 launcher (DoD, 2006). Further, the HIMARS is capable of firing any rocket or missile in the MLRS family of munitions (Baker, 2003). The similarities between the HIMARS and MLRS extend to user instruction: the training of the three-soldier crew remains the same for both systems. Further, the HIMARS is capable of firing any rocket or missile in the MLRS family of munitions (Baker, 2003).

The HIMARS inside of a C-130.

HIMARS Acquisition

In 1996 Lockheed Martin Missiles and Fire Control developed the HIMARS under an advanced concept technology demonstration (ACTD) program. The program's objective was to ensure that the HIMARS could “engage and defeat artillery, air defense concentrations, trucks, light armor and personnel carriers, and support troop and supply concentrations” (“HIMARS”, 2011).

In December 1999, Lockheed Martin produced the initial prototype. In October 2000 a total of 18 extended range MLRS rockets were successfully launched from this system at the White Sands testing facility (“XM142”, 2008). Following successful completion of the Engineering Manufacturing Development (EMD) in April 2002, Lockheed received a Low-Rate Initial Production (LRIP) contract from both the U.S. Army and the Marine Corps in March 2003. The U.S. Army signed a contract for 89 launchers, the Marine Corps for four. A second LRIP contract was awarded in January 2004 for 26 additional launchers (“HIMARS”, 2014).

HIMARS successfully completed the initial operational test and evaluation in November 2004 following their use during Operation Iraqi Freedom. A third LRIP contract was awarded in January 2005 for 38 additional launchers (“HIMARS”, 2014). After final testing concluded, HIMARS entered regular service in June 2005 with the 27th Field Artillery, 18th Airborne Corps at Fort Bragg, North Carolina, with the first full-rate production contract awarded in December 2005 (“HIMARS”, 2014).

In March 2006 Lockheed Martin was awarded a contract totaling $51.5 million for 18 HIMARS launchers (“HIMARS”, 2014).

Following this, the US Army and Marine Corps awarded Lockheed Martin a contract for another 44 and 16 HIMARS systems respectively in January 2007 (“HIMARS”, 2014). Lockheed Marine began full-rate production in Camden, Arkansas in April and the first Marine Corps battalion, 2nd Battalion, 14th Marine Regiment, was equipped with HIMARS and deployed to Iraq in July (“HIMARS”, 2014).

HIMARS completed 255 out of 257 dry-fire missions and 17 out of 17 live-fire missions for a 99.2% and 100% success rate, respectively, in 2008 (“XM142”, 2008). This success rate was reported in the Live Fire Test and Evaluation (LFT&E) report to the congress in March 2008. The following year, in January 2009, a contract for 57 launchers for the Army and several launchers for the Marine Corps was placed (Army-technology, 2014).

In January 2011 Lockheed Martin signed a $139.6 million contract with the Army to provide 44 combat-proven HIMARS, thus increasing the launcher fleet to 375 with deliveries continuing through January 2013 (Lockheed Martin, 2011). The Army and Lockheed Martin celebrated the delivery of the 400th HIMARS in September 2011, the Army received 300 launchers while the Marine Corps received delivery of 100 (Lockheed Martin, 2011).

III. Performance Based Logistics

Over the last decade, the DoD has focused on reducing the cost of weapons system development, in addition to the products and services that it purchases, by crafting more sophisticated contracts with more favorable terms for the government (Butler, 2013). In addition, the services are increasingly diverting their attention to sustainment costs— which are continuing to increase across the DoD— in part because systems are aging more rapidly because the services cannot afford to buy replacements.

The DoD has identified PBL as its preferred approach to supporting weapon system logistics. PBL contracting, when used appropriately, can reduce sustainment costs relative to traditional, organic approaches. PBL is a logistics support solution that transfers inventory management, technical support, and the supply chain function to a provider who guarantees a level of performance at the same or reduced cost. Instead of buying spares, repairs, tools, and data in individual transactions, PBL entails the purchase of a predetermined level of availability that meets the warfighter's objectives.

A History of Success

In most cases, PBL contracts are multi-year agreements (typically with options that can extend the contracts for 5 to 15 years) according to which the chosen contractor manages a given system's supply chain. Whereas traditional sustainment contracts incentivize the provider to sell parts, PBL's "pay for performance" approach motivates the provider to reduce failures and resource consumption. These long-term partnerships with industry often leverage commercial best practices, and there is ample empirical data that demonstrates that PBL produces desired outcomes in the key performance areas of availability, reliability, logistics footprint, and cost.

Major systems including the C-17, F/A-18, and AH-64 helicopter have all reduced sustainment costs by hundreds of millions of dollars, while other systems and subsystems such as the F-22, UH-60 avionics, and F-404 engine have seen drastic improvement in availability and cycle time, i.e. logistics response and repair turnaround; (Fowler, 2009). Other government reports (e.g. Office of the Secretary of Defense, 2009) and think-tank studies conclude that PBL offers distinct benefits that are difficult to achieve using traditional approaches.

The PBL Model

PBL's economic model incentivizes manufacturers and suppliers to innovate and reduce total system and life cycle costs by making investments in improved reliability.

There are three typical components of the PBL contract pricing structure:

- Share-in-savings to incentivize provider to lower overall sustainment costs
- Incentive fee to reward provider for meeting performance expectations, and
- Annual fixed-price or fixed-price per operating hour contract schedule to provide payment to provider regardless of quantity of parts or services consumed (Deloitte 2010).

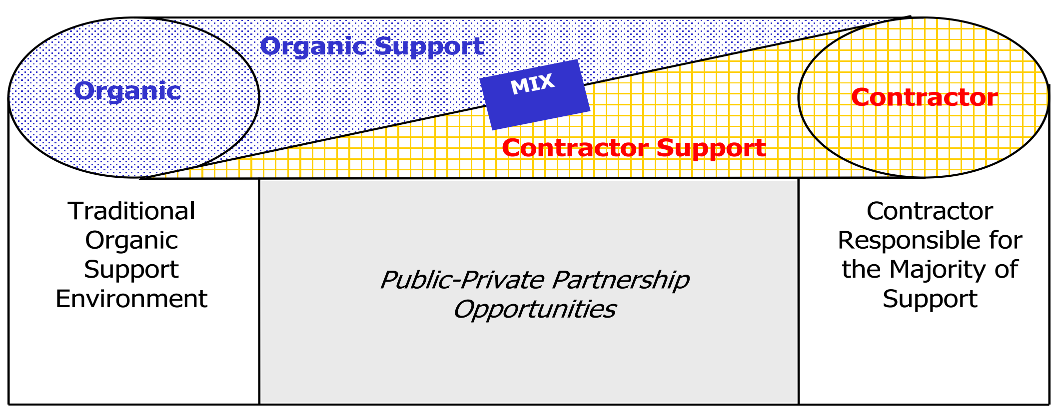


Figure 4. Spectrum of PBL strategies (Defense Acquisition University, 2005)

Figure 4 illustrates how the DoD and private industry can partner and share the support functions, when transitioning to PBL. The Program Office can combine organic support (the DoD) and contractor support (private industry) to meet sustainment strategy objectives. The allocations of support responsibilities are often based on factors such as the age of the system, existing support infrastructure, organic and commercial capabilities and legislative and regulatory constraints. The goals of PBL contracts are to provide the U.S. military with a higher level of logistics efficiency and effectiveness; to improve accountability; and to promote the development of more reliable products. Based on the experience of the private sector and the pilot programs conducted in the DoD, it is widely believed that PBL support offers the best approach for long-term support of weapon systems, and their subsystems (Gansler & Lucyshyn, 2006).

When implemented, PBL shifts the focus of the government's efforts from transactions to identifying performance outcomes and assigning responsibilities. The objective is to develop accountability, instead of relying on control. With PBL, active management of the sustainment process (e.g. forecasting demand, maintaining inventory, and scheduling repairs [see Figure 5]) becomes the responsibility of the support provider. Additionally, it changes the incentives for the supplier. The supplier, with a properly structured PBL program, is now incentivized to improve the reliability of systems, and reduce inventories of spare parts; and with fewer repairs made and fewer parts sold, the contractor stands to make more profit. While from the government's perspective, PBL results in optimizing total system availability; and, at the same time, minimizes the cost and the logistics footprint (Gansler & Lucyshyn, 2006).

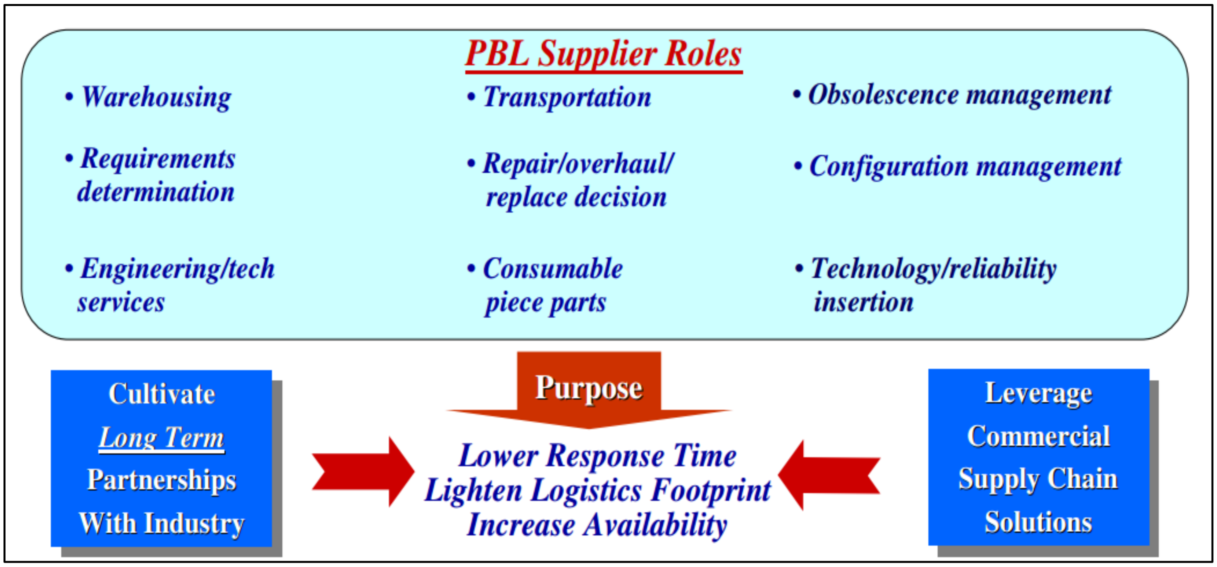


Figure 5. A reengineering tool to improve readiness through reliability (Naval Supply Systems Command, 2005)

Advantages of PBL

PBL programs rely on commercial sector supply chains which are fully-integrated, end-to-end, systems. Unfortunately, comparable systems do not exist within the DoD .The DoD's traditional approach has been fragmented, with segmented accountability and control by various stakeholders (Defense Logistics Agency, services, and depots) all of which have their own budget requirements and restrictions, and different priorities. Additionally, the responsibility for the elements of logistics has been shared between acquisition activities and sustainment activities. Traditional logistics metrics are focused on internal logistics processes, and rarely have a direct relationship to warfighter requirements. Moreover, efforts to optimize these elements often results in sub-optimal results at the system level (Devries, 2004).

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

There is no doubt that the DoD must move away from its traditional hierarchical command and control structure towards a more adaptive system that will provide the precise, agile support required for the distributed, network-centric operations that the DoD envisions. Thus, the DoD must fully embrace PBL, in order to continue to take advantage of world-class supply chains.

In addition to the logistics benefits, there are four distinct advantages associated with the use of PBL contracting. These advantages are summarized below.

Delineates outcome performance goal

The objective of PBL programs is to buy measurable outcomes based on warfighter performance requirements. These requirements should consist of a few simple, realistic, consistent, and easily quantifiable metrics focused on operational performance and value-added process indicators. These metrics can then be linked, through the contract vehicle, to supplier incentives.

Ensures responsibilities are assigned.

A PBL effectively transfers most of the risk and the responsibility for supply chain management from the customer to the supplier for the system, subsystem, or component that is managed. For example, pre-PBL, the DoD customer did not have the visibility to make financially-sound decisions, given the many "silos" associated with the full spectrum of the traditional supply chain management (e.g. acquisition, engineering, procurement, comptroller, and logistics). With a PBL contract, the customer understands the true cost of the support, rendering his financial forecasts and budgets much more accurate. Additionally, the PBL metrics, when properly developed, define the suppliers' responsibilities very clearly. For example, part or system availability is unambiguous. For instance, if the contract calls for the delivery of a part within 48 hours, to be achieved 95 percent of the time, then it is evident to all whether or not the supplier is meeting its obligation (Keating & Huff, 2005).

Reduces cost of ownership

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

Provides incentives for attaining performance goal

Each PBL initiative should be unique and tailored to its program, and should strive to be a "win-win" for both the customer and the supplier. The PBL program should fundamentally align the interest of the supplier with that of the customer, and lead suppliers to assume greater responsibility for providing ongoing improvements to their products. PBL provides incentives for the supplier to improve design and processes and implement commercial best practices (Gansler & Lucyshyn, 2006).

Decline in PBL Contracting

Recently, the Undersecretary of Defense (AT&L), Frank Kendall, directed acquisition officials to renew their pursuit of performance-based approaches to system sustainment and maintenance. Given its history of success, it is unclear why PBL is not being aggressively pursued across the DoD. According to the consulting firm, Deloitte, the DoD could realize cost savings in the area of $20 billion by transitioning current support contracts to PBL ("Performance-based Logistics Promises Savings", 2014).

In 2005, there were more than 200 PBL contracts in place within the DoD (Gansler, Lucyshyn, Harrington, & Corl), with spending on PBL projects having more than tripled since their inception — from $1.4 billion in 2001 to $5.0 billion in 2009. Yet by 2013, the number of PBL contracts had dropped to 87 (Irwin, 2013), while total DoD sustainment costs continued to increase. It is unclear what has prompted this precipitous drop in PBL contracting. Joe Chenelle, managing director at Accenture, a consulting firm, posits that the DoD has become suspicious that suppliers are making excessive profits. He points to the lack of visibility inherent in PBL contracting, and suggests that DoD managers prefer to control costs through the use of transactional sustainment approaches. Given today's budget realities, the DoD must be willing to relinquish some control in exchange for lower overall costs and better performance.

PBL Challenges

Critics suggest, perhaps rightly, that PBL arrangements can be more challenging to develop and manage than other contract types. Just as an appropriate PBL program structure aligns the incentives of the customer (the government) and the support provider, leading to a win-win scenario, an inappropriate structure can create perverse incentives, and result in undesired or unintended consequences. Again, a successful PBL program relies on performance metrics that are straightforward, measurable, and achievable. Moreover, these metrics must be carefully developed and implemented, monitored, and evaluated. The performance-based agreement between the user and the program office should specify a range of support to accommodate changing priorities and resources availability, adding flexibility to the derived metrics.

A successful PBL program requires continuous communication between the program office and the support provider, during both the negotiation and the execution of the PBL contract. These communications will enable the necessary mutual understanding of scope that must occur for successful implementation of the contract.

IV. The HIMARS PBL

The Army awarded the first HIMARS PBL contract to Lockheed Martin in the amount of $96 million in February 2004 (Lockheed Martin, 2004). The four-year contract, referred to as Life Cycle Contractor Support (LCCS) ended in December 2007. At this point, the Army had acquired 195 HIMARS; the Marines had acquired 40. Given its increasing inventory of HIMARS, the existence of a successful partnership between the Army and Lockheed Martin, and the cost benefits that derive from economies of scale, the Marines sought to support its launchers through LCCS upon completion of the initial contract.

Accordingly, the second contract (LCCS II), a three-year contract worth $90 million, was awarded in January 2008 to support both the Army and Marines' systems. The shorter duration of LCCS II reflected significant risk associated with unknown launcher production quantities and price fluctuations for component spares (Gardner, 2008).

The LCCS contracts entrusted Lockheed Martin with the full support responsibilities for the performance-based product support of the HIMARS and MLRS M270A1 launchers' fire control systems, as well as the HIMARS launcher-loader module (Lockheed Martin, 2014). The commonality of support for the two platforms allowed the Army and later, the Marines, to maximize economies of scale in order to reduce costs (DoD, 2006).

The LCCS concept represented a significant evolution from the original M270 MLRS strategy, according to which the majority of tasks (e.g. initial provisioning, inventory management, war reserve stock, repair and overhaul, depot maintenance, etc.) were provided with organic support (Reed & Reed, 2003). LCCS, on the other hand, represents an ideal partnership, one in which the contractor assumes responsibility for providing technical support and user training in order to meet performance objectives while at the same time maximizing existing Army depot and acquisition infrastructure and relying on military personnel to operate the system (DoD, 2004).

By 2011, Lockheed Martin was supporting 620 Army and Marines fielded mobile launcher systems—396 HIMARS and 224 MLRS M270A1—via firm-fixed price with incentive fee[1] contracts for stateside operations, and cost-plus fixed fee contracts for overseas contingency operations (Gardener, 2008). A third contract, in the amount of $158 million, termed Life Cycle Launcher Support (LCLS), extended HIMARS sustainment through December 2013 for services and through December 2014 for hardware.

In June of 2013, the U.S. Army Contracting Command-Redstone posted a "special notice of proposed contract action" that, in effect, awarded Lockheed Martin the status of sole-source provider for HIMARS sustainment. The Army wrote that

> "Lockheed Martin Corporation is the only source having the experience, expertise, and capability necessary to accomplish this effort. [Lockheed Martin's] experience and technical expertise have been gained over a period of 31 years as the prime contractor responsible for the research, development, and production of the High Mobility Artillery Rocket System (HIMARS) launcher module and HIMARS/M270A1 fire control system." (Army Contracting Command, 2013)

Program Structure

The Lockheed Martin LCCS/LCLS program office is headquartered in Dallas, where numerous program functions are executed including program management, depot repair coordination, inventory control, contracting with suppliers, design interface, and database maintenance (Discussion, 2013). The database tracks the location of each launcher, including each spare part, indicates whether the part is functional, and provides its status with regard to the repair process. The DoD's internal logistics systems rarely achieve this

[1] FAR 16.2 establishes that a firm-fixed-price contract may be used in conjunction with incentives when the incentive is based solely on factors other than cost. In the case of HIMARS, the incentive was based on performance factors.

level of visibility, often leading to ordering redundancy, misplaced orders, and an incomplete picture of program operations.

There are also 26 field service representatives (FSRs) that operate from 22 locations, eight of which are overseas. In-theater maintenance work is performed by soldiers with the assistance of these FSRs (Hawkins, 2009). These FSRs facilitate the supply process by overseeing numerous functions including:

- supply, receipt, storage, issue, inspecting, packaging, and shipping, of subsystems and components;
- data collection and recording (maintenance actions, supply transactions, operating hours, munitions status [deployment and garrison]);
- system fault isolation using a variety of either built in or stand-alone test equipment;
- replacement of assemblies, as required (see Figure 6);
- provision of technical assistance and support (both launcher and automotive); and
- provision of an interface for "reach back" engineering support, enabling the rapid resolution of problems.

Given the level of sophistication provided by the Lockheed Martin's database and logistics networks, the FSRs are able to streamline and simplify the repair process for launchers. As a result, early-on in the PBL program, Lockheed Martin was able to reduce the number of diagnostics devices provided to each battalion from six to one. In fact, soldiers operating the system in theater need only remove and replace defective components (Discussion, 2013).

Figure 6. Line replaceable units (LRUs) and assemblies provided by LCCS (Lockheed Martin, 2012).

Perhaps one of the greatest benefits is the provision of limited depot-level repair capability at each battalion where repair work is provided by the FSR. Referred to as the capability to "Fix Forward," some 50% of all HIMARS repairs are performed on location by the FSRs, eliminating wait times and significantly reducing costs. Moreover, the FSRs are trained to test and replace circuit card assemblies (CCAs), rather than the LRUs in which they are housed, which reduces the overall logistics footprint—only the CCAs need to be shipped—and lowers costs. This in-the-field repair capability has also significantly improved deployed launcher availability (Discussion, 2013).

PBL Requirements

Per the program's performance-based agreement, the HIMARS PBL program measures performance in the following areas:

- system readiness status;

- average response time for critical non-mission capable launcher failures in the continental United States and outside the continental United States;
- average repair time in the field; and
- average depot repair turnaround time (DoD, 2006).

Note the relative simplicity of these requirements, which facilitated straightforward monitoring and, thus, complete transparency. The contract data requirements list also mandated that Lockheed Martin provide the following information; updated on a regular basis:

- emergency action plan,
- transition plan,
- safety reports,
- field weekly reports, and
- field analysis reliability reports (DoD, 2006).

Program Results

Over the course of the last decade, The HIMARS PBL has repeatedly achieved and exceeded the performance requirements. Success was achieved early on. In submitting its list of critical accomplishments for consideration by the DoD Awards Program in Performance-Based Logistics in 2006, the Army's program office noted that Lockheed Martin earned the maximum incentive fee each quarter for having achieved a 99% plus system readiness for every contract quarter (DoD, 2006).

In addition, the critical accomplishments list noted the success of units deployed in support of the Global War on Terrorism. Between 2005 and 2006, HIMARS participated in multiple overseas operations, firing ninety-nine munitions, all of which hit their "specified, pinpoint targets. Moreover, no launcher was in a "down condition" for more than 24 hours since measurements began in April of 2005 (DoD, 2006). The award nomination also noted that "the outstanding performance by [Lockheed Martin] field service representatives has proven that contractors on the battlefield are a viable solution to supporting modern ground weapon systems" (p. 4). The LCCS team won the Secretary of Defense Performance-Based Logistics Award in November of 2006.

Based primarily on data collection provided by Lockheed Martin during the initial contract, the LCCS team was able to make a number of changes to the LCCS II contract that would reduce future ownership costs. Notably, the team determined that the usage hours for the launchers varied significantly between active Army units and National Guard units (DoD, 2009). In an effort to reduce future costs, the less-used units were categorized under a lower operational tempo, which led to a reduction in needed support. Accordingly, Lockheed Martin and the DoD negotiated the LCCS II contract to reflect the anticipated savings derived through the reduction in operational tempo. These savings turned out to be considerable. In 2007—the final year of LCCS I—costs associated with operational tempo totaled $12.4 million; in 2009 these costs had declined to $3.8 million, for a total cost avoidance of $8.6 million, a figure that was used to inform pricing for the subsequent contract (DoD, 2009).

The LCCS II contract required that system readiness be maintained at or above 90% and that response time be below 48, 72, or 96 hours for U.S. based operations, depending on the nature of the problem, 92%, 91%, and 90% of the time, respectively (DoD, 2009). For overseas operations, the response time had to be below 96, 120, or 144 hours (DoD, 2009). The program consistently achieved these objectives at the required percentages in all performance areas. As a result, the LCCS team won its second Secretary of Defense Performance-Based Logistics Award in 2009.

PBL agreements incentivize suppliers to provide many unspecified functions in support of performance requirements. Some of these functions can be overlooked when support is provided through organic sources. For example, LCCS initiated a robust obsolescence management strategy early on in order to ensure that it could meet performance requirements (DoD, 2006). Lockheed Martin regularly monitors the Government-

Industry Data Exchange Program in order to identify potential obsolescence issues. Within the first couple years of the PBL, LCCS evaluated the potential for the obsolescence of numerous components, identified alternate parts, and supported specific redesign efforts (DoD, 2006). Although a natural extension of the PBL strategy, obsolescence management has proven challenging under other contracting or in-house arrangements.

As mentioned, the HIMARS program also tracks reliability through mandated field analysis reports, monitoring the mean time between system aborts (MTBSA) and mean time between essential function failure (MTBEFF). Figure 7 illustrates the reliability improvements in the Army units' reliability between 2005 and 2012, which have been built into the HIMARS system in order to better meet the stated performance goals (Discussion, 2013; Lockheed Martin, 2012).

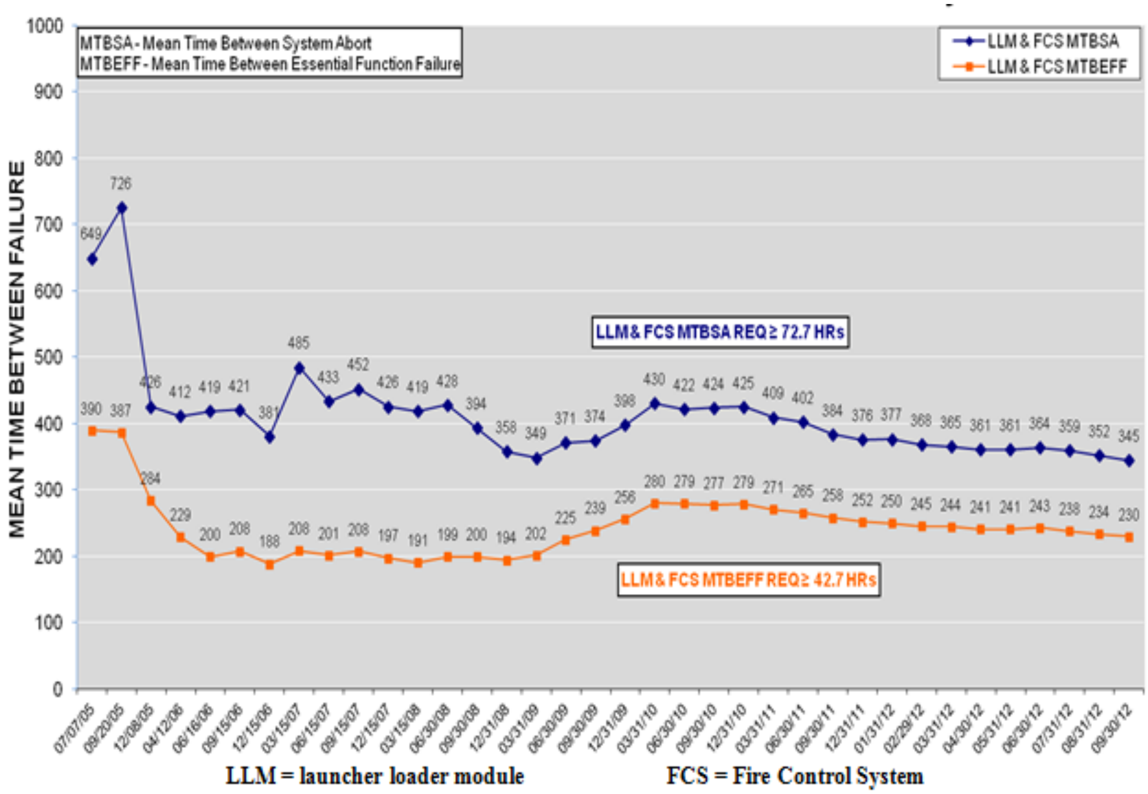


Figure 7. HIMARS reliability over time (Lockheed Martin, 2012)

Notably, the failures have declined across the entire HIMARS system. Figure 8 shows the number of failures for 25 HIMARS parts during a twelve year period early-on in the program compared to a period of twelve months spanning the latter part of 2011 into 2012. On average the number of failures has decreased by about 71% (Discussion, 2013; Lockheed Martin, 2012).

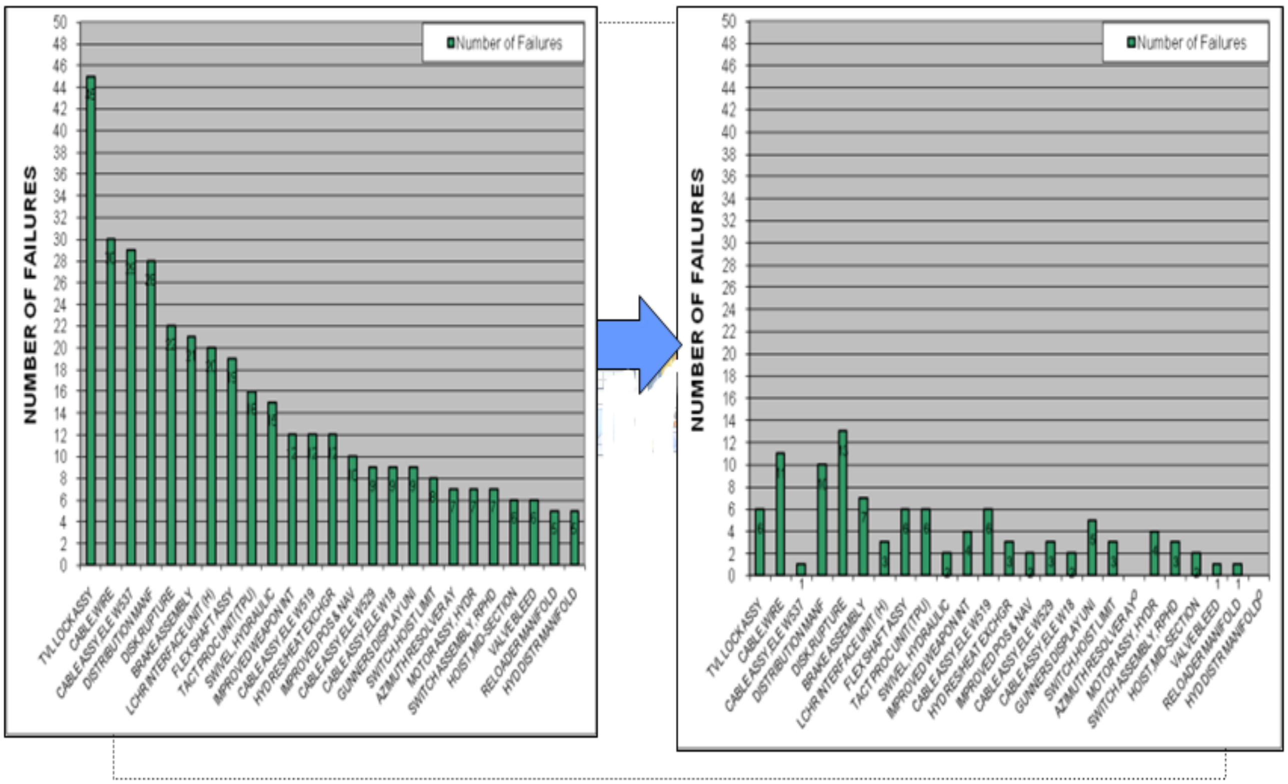


Figure 8. Number of yearly failures for 25 HIMARS parts, early in program (left) and more recently (right) (Lockheed Martin, 2012)

V. Conclusion

The HIMARS experience makes it clear that when properly implemented, PBL strategies can result in reduced costs and continuously-improving performance. The HIMARS PBL strategy worked to ensure that incentives were carefully structured and aligned with the performance requirements of the system. With the incentives aligned, integration between the provider and customer was readily achieved. The support provider, appropriately empowered, was able to work to improve logistics efficiency, improve performance, reduce costs, and make reliability improvements that reduce life cycle costs, resulting in a win-win for both customer and provider.

We have identified a number of the HIMARS program's attributes which we believe can inform future PBL programs, thereby helping to ensure their success:

<u>Alignment of contractor incentives with system and mission performance requirements.</u>

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

<u>Clearly-defined performance metrics</u>

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

A total life-cycle systems management perspective

A life-cycle based perspective will improve reliability and maintainability, and better manage costs. Planning for, resourcing, and executing the design, acquisition, management, and fielding of an integrated product demands that both DoD and private-sector managers manage systems across time, rather than at a single point in time. Longer-term PBL contracts can incentivize the adoption of such a perspective.

Supply chain management

Material support is a critical link in the supportability of weapon systems. The best skilled labor, advanced technology, and high performance mean little without the "right part, at the right place, at the right time." Supply chain management is an area where the commercial sector has developed superior capabilities, and is a primary target for incorporation into PBL implementation.

Public-private partnerships

It is essential to achieve the right public-private mix for each program; with clearly defined and measurable expectations. In addition to satisfying the statutory requirements, using the strengths of the organic and contractor organizations can provide a better logistics solution. Public-private partnerships enable the compliance with statutory requirements, preclude the investment in redundant capabilities, and yet still maintain single point accountability.

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

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

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