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M109A6 PALADIN: THE CHANGING FACE OF DOD ACQUISITION

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14. ABSTRACT

Since the inception of acquisition reform, the Paladin/FAASV office has pioneered changes in DoD acquisition. The DRU-H program is a prime example of this innovation.

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BACKGROUND

Over the last 10 to 15 years, acquisition and logistic reforms have changed the way the military equips the soldier in the field. While strategies have changed, the goal of the acquisition community remains the same: to provide our soldiers with an overwhelming technological advantage. With the implementation of acquisition reform, the refined focus is to remain on the forefront of defense technologies while achieving low life-cycle cost (LCC).

Since its inception, the Office of the Program Manager for Paladin/Field Artillery Ammunition Support Vehicle (FAASV) (fig. 1) has been a strong proponent and practitioner of these new initiatives. Team Paladin has been recognized for their success through several efforts and on several programs. The vehicle's main fire control computer received the Department of Defense Standardization Award for Excellence in 1997. However, the most successful and innovative program run by Team Paladin to date is the procurement, fielding, and support of the Paladin's primary inertial/Global Position System (GPS) navigation system, the Dynamic Reference Unit (DRU) - Hybrid (DRU-H).

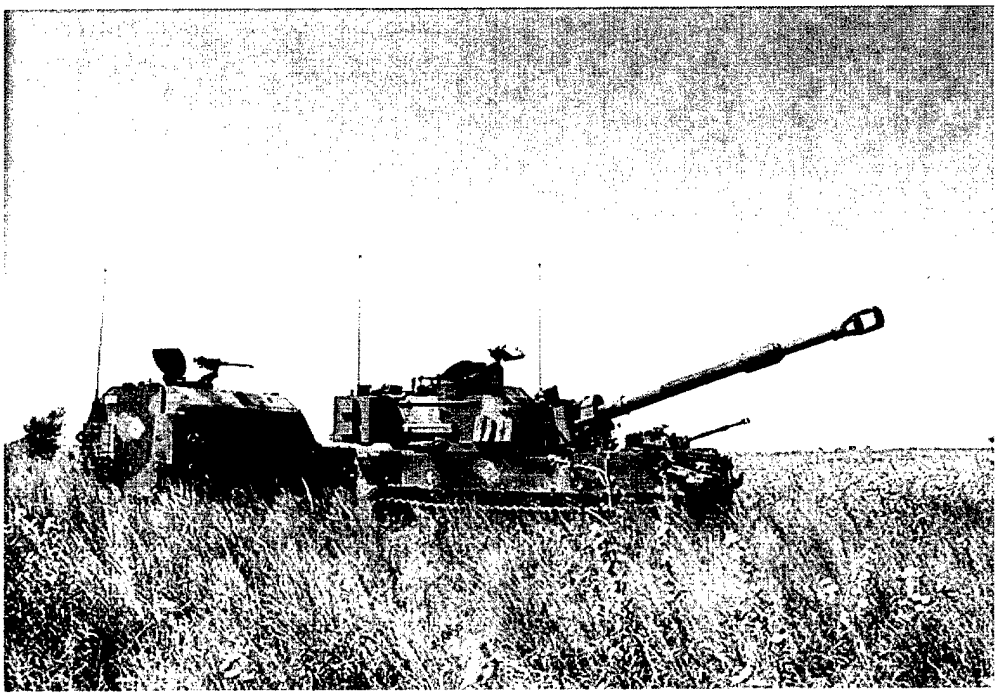

Figure 1
Paladin/FAASV

M109A6 PALADIN

Since being fielded to the U.S. Army, the M109A6 Paladin self-propelled howitzer has become and remains the U.S. Army's premier artillery system. The Paladin began with the goal of enhancing the reliability, availability, maintainability, survivability, lethality, and responsiveness of 155-mm artillery. Some of the major improvements Paladin offers over the M109A5 include: improved armament, crew safety enhancements, and automotive upgrades. The most significant advantage of the A6 is the onboard electronic fire control, communication, and navigation systems that allow for "shoot and scoot" capability.

ELECTRONIC SYSTEMS

The Paladin's fire control system works with the communication and navigation systems to make the Paladin an extremely effective tactical weapon system. These systems include several individual electronic components. The fire control system consists of a main computer, a display screen, and a keypad. The communication system is centered on the Army's standard radio, the Single Channel Ground to Air Radio System (SINCGARS). The main component of the navigation system is the DRU-H.

Paladin was initially fielded in June 1993 with a fire control system that was built to a full technical data package. The current system, the Automatic Fire Control System (AFCS) was fielded to the entire Paladin fleet in 1997. The Paladin's main fire control computer is based on commercial or "PC" technology. The AFCS computer unit (ACU) uses a rotating hard drive, a Pentium processor, and other commercial technologies to perform all fire control functions on board. Designed and procured using a performance specification based upon commercial specifications and standards, the ACU is approaching obsolescence, but continues to operate admirably considering its commercial off the shelf (COTS) technology. Sample data collection (SDC) conducted by the Office of the Program Manager for Paladin, has estimated the mean time between failures (MTBF) for the ACU is just above 2000 hrs. By maximizing the use of commercial products in the AFCS, the cost of providing on board fire control has drastically decreased since the first fielding of the Paladin.

DYNAMIC REFERENCE UNIT - HYBRID

Although the fielding of the ACU was a significant accomplishment, the success of that item pales in comparison to the M109A6's main navigation unit, the DRU-H. Fielded in 1993 as an upgrade to the original DRU (fig. 2), the DRU-H performs several functions for the crew. With or without the Precision Lightweight GPS Receiver (PLGR), the DRU-H provides accurate position, gun tube pointing, and attitude data to the fire control system (fig. 3). When the PLGR is installed, the DRU-H is bounded by the PLGR for position data because of the PLGR's greater accuracy and consistency over time. However, the PLGR does not readily provide pointing data to the AFCS. The capability is provided solely by the DRU-H. The DRU-H also provides gun slew rate feedback.

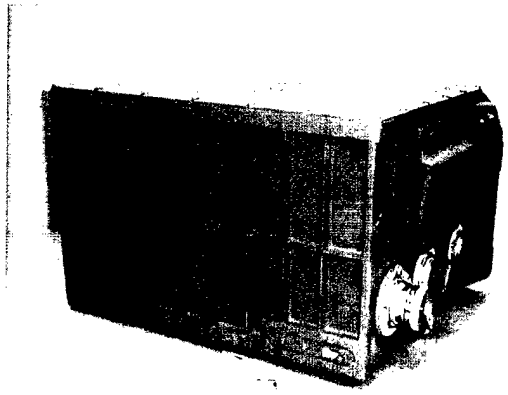

Figure 2
DRU

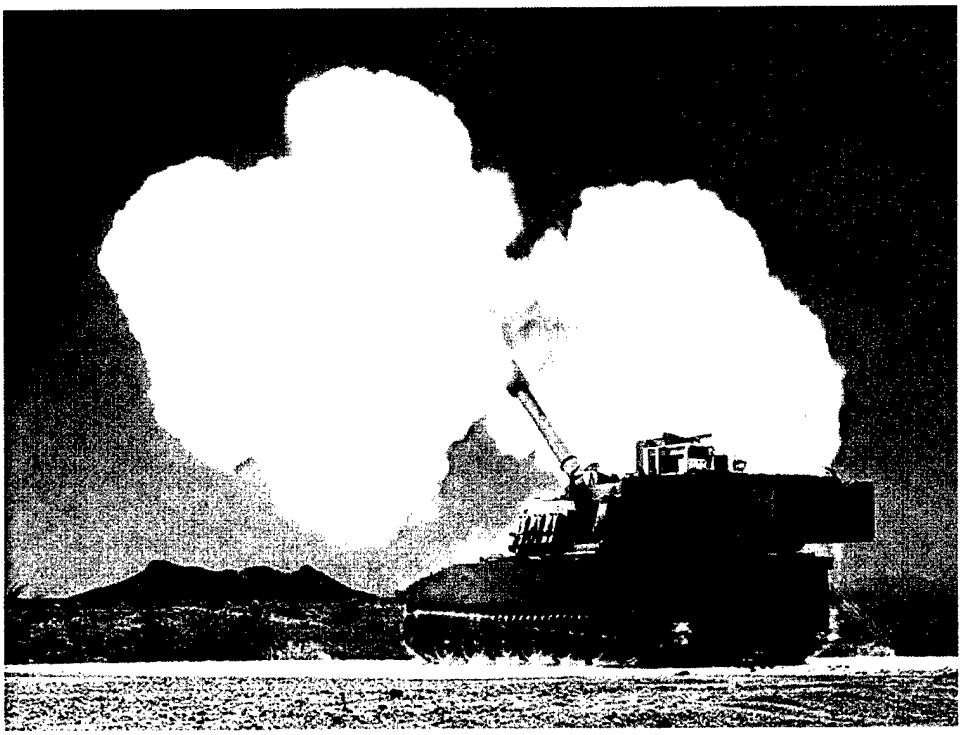

Figure 3
Paladin with DRU-H

The DRU-H has met and exceeded the requirements set during the procurement phase. The most impressive statistic is the DRU-H's reliability. The same data collection activity that reports the ACU's reliability data also collects data on the DRU-H. While the ACU achieves relatively good reliability numbers, the DRU-H reliability numbers are staggering. Almost 10 yrs after the initial fielding of the item, the reliability data continues to be impressive. The DRU-H has shown only 14 failures at SDC sites over the past 6 yrs. This equates to a MTBF of over 15,000 hrs. When reviewing the performance of the entire group of fielded DRU-H's, the reliability data is even more impressive. With 1200 units in the field, only 23 DRU-H's required repair last year. With an estimated average running time of over 700 hrs per unit per year, this places the estimated field MTBF above 30,000 hours.

The DRU-H achieves this outstanding performance under the most severe gunfire shock environments. Mounted directly to the vehicles trunion, the DRU-H is subjected to the full effects of the firing blast and recoil shock of each 155-mm round. It is also subjected to extreme temperatures and other detrimental environments. The DRU-H has continually proven to survive the worst aspects that the battle environment has to offer. This performance can in part be attributed to the use of military grade components, but the procurement strategies and contracting tools used in this acquisition also played a major part in the program's success. This exceptional performance is attributed the LCC acquisition strategy for the DRU-H.

ACQUISITION REFORM AND INNOVATION WITH LOGISTICS

Development of the Modular Azimuth Position System (MAPS), which included the DRU, was started in 1984. In 1986, the procurement of the DRU for the M109 began with a performance specification as the sole technical document. Although procuring to a performance specification is a standard practice today, this was a rarity for the Army in 1986. The DRU was originally designed to a Military Standard (MIL-D-70789(AR)). In 1991, the DRU was upgraded to interface with the PLGR; developing the DRU-H. The DRU program strategy also made use of an Air Force acquisition model that stresses LCC and contractor logistic support (CLS). Based on those strategies, the OPM made the decision to trouble shoot the DRU-H at the Line Replacement (LRU) level. Using the DRU-H built in test (BIT) eliminated any need for investment in interim support equipment or provisioning large quantities of spare sub-assemblies. All failures are simply returned to the contractor for repair.

From the initiation of this program, a conscious decision was made to focus on LCC and CLS for all facets of maintainability, including obsolescence. The emphasis on CLS allowed the Army to eliminate the overhead expenses of establishing and maintaining an organic depot repair capability, which would normally include the cost of test equipment, personnel, and facilities. In addition, neither technical data nor data rights for proprietary software were purchased by the government for support of the DRU-H; the only documentation required was the performance specification (MIL-PRF-71185). In place of establishing the archetypical logistics solution, this program included innovative acquisition tools such as a reliability improvement warranty (RIW). This tool was also adapted from Air Force acquisition models. At the time, the Air Force had an RIW in place for its form fit, function (F^3) multiple application inertial navigator. The basis of such an acquisition is to make the prime contractor ultimately responsible for the reliability of the product. The RIW provides incentives for the contractor to make improvements to his product and implement changes as more reliability data is obtained. The Army leveraged this RIW concept in the procurement of the DRU-H because the DRU-H design had 80% commonality. Under a RIW, the contractor is bound to a fixed price for total support during the warranty period. This provides a direct financial incentive to the contractor for improved reliability. Because the DRU-H is based on a proven Air Force design, the contractor had the confidence in their product to offer a firm fixed price per repair. Due to the excellent reliability, the contractor is able to support the repair contracts for over 16,000 navigation units from the same repair center location. Years later, these innovative acquisition techniques have proven to benefit the acquisition community, the contractor, and ultimately the U.S. Army.

PROS/CONS OF SUCCESS

Even though this acquisition was a tremendous success story to the Army as a whole and the taxpayer, there was a downside to the soldier in the field. The problem is one of significant repair cost to the soldier, as compared to the cost from the vendor. Unit production cost for a new DRU-H to the Army was $88,000 per unit. The cost to the Army for a repair ranges from $600 to $8,800, depending on type and severity of failure. However, the cost to the soldier is $47,000. This significant cost difference is driven by the Army Working Capital Fund (AWCF) system. As the Army transitions to commercial business practices and contractor logistics support, the AWCF system will also need to be addressed to insure that the savings achieved by this transition are appropriately addressed and most effectively leveraged. The real benefit to minimizing or circumventing the cost of AWCF will be the ability to pass the savings on to the ultimate customer, the soldier.

CONCLUSIONS

The M109A6 Paladin is and will continue to be the premier artillery piece for the U.S. Army. Further improvements will have to be procured and fielded to meet future operational capabilities. The Army's identified need for accurate, timely, and reliable indirect fires will fuel the future upgrades of this vehicle. The lessons learned are most applicable to electronic devices and are currently being applied to the acquisition of the Paladin's next generation of fire control. In order to guarantee an overwhelming fighting force, the Army must leverage these successes and continue to adopt such innovative technological and business strategies.

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