
CANNON-BASED FIRES: LOOKING TO THE FUTURE

OTHER POTENTIAL ALTERNATIVES TO CRUSADER

Given its acquisition cost, timing, and the current budget environment, the need for Crusader among other U.S. Army priorities is likely to be examined and reexamined. On one front, many believe that cannon-based self-propelled fire support is essential to the future Army (as it has been for the past fifty years) but believe that either a Paladin, an improved Paladin, or foreign system (e.g., Germany's PzH 2000) can accomplish the job. However, others believe that cannon-based self-propelled fire support is less essential to the future of the Army, and they see advances in rocket artillery and submunitions (e.g., Inertial Navigation System (INS) or Global Positioning System (GPS) rocket guidance and increasingly brilliant munitions such as BAT P3I or Damocles) or new technologies such as fiber-optically guided missiles (e.g., EFOG-M) as being able to perform an increasing number of missions once accomplished by cannons.

In the first case, with respect to cannon alternatives to Crusader, a number of studies show the various merits and costs of such alternatives. Our assessment suggests that the current Paladin system is becoming outclassed by other systems. Limitations to the M109 chassis preclude key system-level modifications that would make Paladin competitive with the better foreign systems. To some extent, additional upgrades to Paladin may come at the expense or reduction of other key capabilities (e.g., a larger gun might further reduce mobility because of the greater weight).

Also, we did not come across any studies that show the tradeoffs associated with foreign systems. It has been established that many foreign systems, while having a number of desirable features, do not meet at least some of the requirements outlined in the operational requirements document (ORD). One of the notable foreign front runners, the PzH 2000, built by Wegmann & Co. GmbH, does not satisfy the requirements for extended-period rate of fire, fully automated operation, or connection to the U.S. Army's advanced field artillery tactical data system (AFATDS) fire control architecture. It also does not currently have a companion resupply vehicle.

However, discussions with Wegmann representatives suggest that they believe the PzH could be modified to meet the SPH requirements for Crusader. Additionally, PzH 2000 is expected to offer a number of favorable characteristics, including reduced gun overhang for maneuver operations in tight spaces, manual backup should electronics fail, and early availability. Such foreign systems may involve some key concessions, but they may also result in substantially lower acquisition costs.

To address the concerns about the future role of cannons in light of new and emerging concepts (e.g., the validity of the ORD) and the ability for alternatives other than cannons to provide capability, we did not find very much supporting analysis. Although one notable study performed by the U.S. Army Field Artillery school examines the need for cannons and rockets, this analysis primarily focuses on today's technology and does not include many of the planned improvements to rocket artillery or submunitions.¹

Also, our examination revealed that little has been done in the way of force effectiveness analyses to address the presence of new technologies such as an EFOG-M or new systems such as Comanche to assume some of the missions that might involve cannons. On an even broader front, changes in Tac Air will have an effect on the close battle. New weapons coupled with planned aircraft have the potential to provide increased fire support; at the same time, there is much

¹U.S. Army Field Artillery School Study, *Cannon Vs. Rockets*, presented at RAND by LTC James Cummings.

rhetoric about reducing close air support in the future.² Regardless of whether more or less Tac Air will be available, the advantage that cannons have over aircraft in adverse weather conditions will likely remain well into the future. All these issues have implications that impact future SPH needs, both in character and number.

STRENGTH OF CANNONS IS VERSATILITY AND LOW-COST DELIVERY

In light of the above, it is also important to emphasize that as new technologies such as rocket artillery evolve, they lack some of the advantages of cannons. For one, cannons provide a large degree of versatility. They can deliver a number of munitions including high explosive (HE), improved conventional munitions (ICM), dual-purpose improved conventional munitions (DPICM), Copperhead, sense and destroy armor (SADARM), and different types of mines. They can also deliver nonlethal payloads such as smoke and illumination rounds, which are often critical to the battle outcome but difficult to assess effectively in models and simulations. This versatility, along with their accuracy and the penetrating capability of the projectiles, makes cannons a key player in urban warfare. Extrapolating to the future, one can envision cannons as a key method for deploying sensor networks, communication relay nodes, and jammers because of their precision and efficiency.

Furthermore, cannons tend to be a less expensive option than rockets for delivering payloads. Figure 10 illustrates this point to an extreme by showing that the cost of delivering a single SADARM munition by cannon is considerably lower than by rocket (the figure does not include the cost of the platform and other prorated operational costs).

The SADARM version for 155mm cannon delivery is currently being produced in low quantities—a single 155mm round can deliver two SADARM. Although the MLRS version of SADARM has been canceled, it does illustrate the point being made here. The payload for a standard unguided MLRS rocket was six submunitions, four sub-

²If close air support is reduced, the Army could require larger amounts of organic fire support in its units.

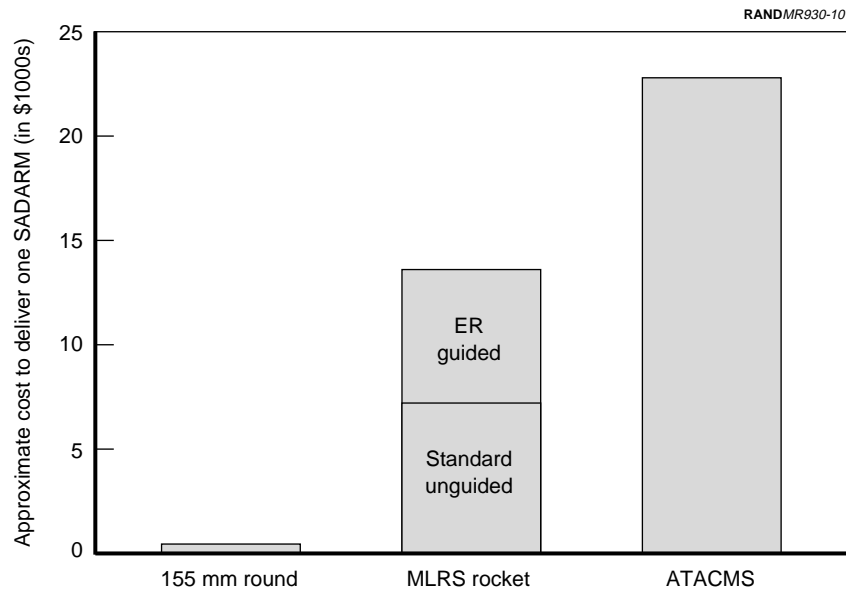


Figure 10—Cannon Delivery Cost of Munitions Is Much Less Expensive Than Rocket Artillery

munitions for the extended-range (ER) guided rocket. Although the cost per submunition was often cited as an area of concern against the acquisition of SADARM (during the Milestone IIIA decision, SADARM was expected to cost around \$17,000 per submunition), it is evident that the cost to deliver the SADARM via MLRS would quickly approach the cost of the submunition itself. Taking this one step further, the cost to deliver the 31 SADARM via ATACMS³ would have well exceeded the cost of the submunitions.

CRUSADER'S ROLE IN THE FARTHER FUTURE

A number of different future concepts are assessing and even experimenting with revolutionary ideas for ground warfare along with aggressively applying new technologies. These concepts emphasize

³It has been estimated that 31 SADARM can be packaged into a single ATACMS.

smaller, lighter-weight, even air-mechanized forces that can deploy rapidly and fight with significantly larger amounts of remotely located fire support. Although these remotely located fires are, in concept, augmented by advanced organic fires, these organic fires are not generally provided by cannons. Rather, other lightweight, rocket-based systems are seen as providing much of the organic indirect fire. Thus, the future of cannons in these concepts is questionable.

However, as visible as these rocket-based future concepts are, their viability is still largely indeterminate at best. In the meantime, there is an operational need for responsive fire support. This need can potentially be met by Crusader. Further, cannon-based fire support historically has been seen as and in some cases proved to have been a major killer on the battlefield. While technology has the potential to change this view with new types of indirect fire alternatives (e.g., EFOG-M), many of these systems have yet to be demonstrated. Currently, ground forces rely on cannons to provide many types of fire support with many different objectives. A replacement for any aspect of the cannon fire support mission cannot be treated lightly.

Crusader appears to be a good match with the Abrams and Bradleys of the current force. Although such systems collectively will constitute the backbone of the fighting force through the Army XXI period, as the Army enters the next generation, such as the AAN era, the Abrams and Bradleys will most likely be phased out as the new combat vehicles such as the FMBT and FIFV enter the force. Because of the timing of its acquisition, Crusader is still likely to be in the force when this change takes place. However, it may not match well with highly mobile, possibly air-mechanized, systems envisioned for ground combat in the far future. Further, it is unclear how the fire support needs will change, given the many possibilities for new concepts in ground combat. Given this, some planning for uncertainty can be conducted, which might include revisiting the number of systems purchased or exploring potential modifications of or variations to the system.

While Crusader clearly has a place in the current Army and Army XXI, it is unclear how well it will fit in the future. Initial “signposts” suggest that the system may not constitute a match with many of the emerging concepts for ground warfare, particularly because of its

weight. Nonetheless, we note that such concepts have yet to be demonstrated; many of the technologies needed to get there are still unproven. The emerging light-force concepts being developed for the AAN period constitute the area where Crusader would have the greatest difficulty “fitting in.” It is, however, by no means clear yet how light forces of 20 or more years hence will be configured or how they will operate. The best use for the Crusaders that will be present in the first part of the AAN era will be to support future mechanized units. With the Army already planning for a follow-on for the Abrams and Bradley (both envisioned for the 2015–2020 period), it appears relatively certain that there will be future mechanized units of some form, in addition to the possible light air-mechanized units of AAN. As we have already pointed out, some of the technologies that are being developed for Crusader today will probably be transferable into the successors to the Abrams and Bradley. Here, several of Crusader’s components have the potential to serve as a starting point for demonstrating, developing, and refining critical technologies that can then be applied to a lighter-weight system for the future.