Mechanized Tube Artillery as an Integral Element of Expeditionary Forces

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Alternatives to artillery

Somewhat before the demise of the Crusader system, which would have been the world's heaviest mechanized howitzer, a vivid debate on the future of artillery began. This has further intensified in the related debate between the proponents of solid armor and the advocates of 'traveling light'.

Some military experts[1] believe that artillery, particularly its mechanized variant, has lost much ground to the relatively simple and rugged mortar for indirect-fire support. They argue that the mortar is effective because of its organic integration with the lower levels of tactical ground mobility (i. e. battalions and companies), its short reaction time, its high rate of fire and, especially, its lower weight that lends itself to rapid transport over longer distances (strategic mobility). For these experts, the mortar's advantages in the present strategic environment constitute a 'renaissance of the mortar.'

Mechanized artillery systems, which give protection to their crews, are said to be far too heavy to meet the challenge posed by contemporary scenarios that require speedy operational or strategic deployment. In contrast, mortars, weighing only several hundred kilos, can be used in paradrop operations and also issued to heliborne infantry. And it is suggested that in scenarios involving counter-battery fire (in other words, an adversary striking back at one's own positions) mortars can be mounted on armored personnel carriers in order to give their crews some protection with a systems weight still considerably below that of standard mechanized artillery.

There is yet another faction of military experts, however, who express grave doubts in the raison d'être of state-of-the-art artillery.[2] They may or may not accept the notion that there has been a renaissance of the mortar in the context of modern intervention scenarios. But this is not their real concern. Instead their interest focuses on a revolutionary solution to the problem of indirect-fire support for ground-mobile forces – namely on the systematic "tapping" of all elements of fire that can be brought to bear in a given location, in the shortest possible time. In this context, the buzz word is networking, or *network centric warfare*, to be made possible by advanced means of electronic communication and data processing.

They believe that inter-arms and inter-service networking would render realistic a flexible combination of fires from rather different sources: such as naval artillery with enhanced (inland) ranges and increased precision, fixed-wing or helicopter gunships,

[1] see for example, John Boatman, Murray Hammick, and Gérard Turbé, "Mortar Moves," *International Defense Review*, Vol. 25, December 1992, pp. 1157-1162.

[2] see for examples, Huba Wass de Czege, "Revlutionizing Firepower: the enabling destructive and suppressive element of combat power," *Field Artillery Journal*, 01 July 2003 and "Network Centric Warfare," DoD Report to Congress, 27 July 2001.

armed UAVs, cruise missiles, tactical ballistic missiles, fighter bombers and even strategic airpower with modern munitions. In the extreme, one might imagine a battalion of land forces engaged in a peace-making effort getting adequate tactical fire support without reliance on any ground-mobile artillery.

Alternatives and their shortcomings

The proposed alternatives to modern artillery are not as convincing, however, as they appear at first glance. Let us first examine the case of the mortar. Such weapons have quite limited effective ranges. Normally their radius of fire does not exceed 10 km which translates into an area coverage of about 300 square-kilometers. Likewise there is a significant limitation on their caliber. In general it is not larger than 120 mm. Mortars with larger calibers have been phased out nearly everywhere. Their clumsiness, high weight and forceful recoil, which demand fairly heavy, tracked platforms, neutralize the key advantages of the mortar, namely its lightness and flexibility.

By comparison, standard tube artillery has a larger caliber (West: 155 mm / East: 152 mm) than practically all mortars. As a result there is much more volume for explosives and warhead sophistication - i. e. bomblets and precision guidance. This fact must be weighed against the higher firing rate of the mortar. Furthermore, standard tube artillery typically has a longer range, of about 40 km, which translates into an area covered of roughly 5,000 square-kilometers: over 16 times more than achieved by the mortar. This allows a few gun batteries in separate locations, but with overlapping ranges to deliver tremendous fire concentrations. Its capacity to rapidly concentrate fire gives considerable advantage to tube artillery in any comparison of cost-effectiveness of mortars, artillery and other means of fire support. It should also be noted that unlike most mortars all tube-artillery pieces can be employed in the direct-fire (line-of-sight) mode: something that may prove life-saving in an emergency. Think of a battery of guns that all of a sudden has to deal with a breakthrough of insurgent forces![3]

[3] Recently a few mortars capable of line-of-sight fire have been developed; an option gained at cost increases and losses in ruggedness.

The organic integration of the mortar component with battalions and even companies of the ground forces can indeed be tactically advantageous. But it should not be overlooked that artillery, albeit at higher levels of organization, also enjoys a degree of integration that could be helpful in providing its personnel with an adequate frame of reference or “situational awareness” in the sense of receiving guidance through human interaction. This is exactly what would be missing if there were total reliance on networking with many critical military assets belonging to other organizational entities.

Traditionally the key advantage of artillery over mortars lies in its optimal access to intelligence. Often the only relevant information that mortar crews get are more or less garbled target reports from forward troops. The artillery may receive the same, but has at its disposal ample facilities to collect and systematically evaluate other data: to verify troop reports and guide its fire.

In order to cross-check troop reports, to complement or to substitute for them, modern artillery management systems integrate and process data from a broad spectrum of sources: among them acoustic sensors, counter-battery radar, photographic or thermal images gathered by UAVs of varying ranges and endurance or by tactical-reconnaissance aircraft. Satellite information can be factored in as well. Along with operational guidance, all this information, which is for the most part real-time (or near-real time), forms the basis of modern artillery’s command and control systems.

The advocates of network-centric warfare suggest that the artillery should lose its privileged access to battlefield intelligence. They propose to give all relevant data to all assets of fire or at least to all organizational positions in charge of ordering fire. This implies that the leader of a mortar company would immediately have available several additional sources of intelligence: ideally those that could enable him to optimize his unit’s fire.

There might be strings attached, however. Who decides, for instance, which information is really useful for a mortar company? If it is the company commander himself, he may suffer from information overload and thereby feel hampered in his ability to quickly react to a challenge. And if it is some higher-echelon position, the results might be delays and, again, losses in flexibility. Generally speaking, data have to be used that come from rather diverse – and organizationally distant sources; a fact that may give rise to questions about their reliability.

And there may arise comparable problems if at a higher level of organization, say by the commander of a battalion or larger combat team, concentrated and immediate fire support is needed. According to the “networkers” all relevant target and battlefield information would be made available and at the same time linked with all potentially applicable assets of fire. Again we have the question of relevance: who selects the data according to their usefulness – and with what effect on flexibility and timeliness? Can the data be trusted as if they were coming from an information system of long-standing integration, specialization and practice – organizationally close to the fighting formation? In other words, would the intelligence be as valid as the one provided by an organic artillery information system?

And finally, we find in this context a problem of fire allocation. In the case of an assumed posture without or with only insufficient artillery, for reasons of cost there cannot always be air- or seaborne fire assets within easy reach to provide support in a quick-reaction mode and with the right “dosage”. Often relatively long distances would have to be covered, resulting in tactically unacceptable delays. Furthermore, the assets available in a given region may only be able to produce the “wrong” kind of fire: too big or too small a blast or not sufficiently accurate (we know, for instance, that GPS-based navigation, which has become so popular with the U.S. forces, does **not** provide the acme of precision).

There may also be situations characterized by a momentary affluence of fire assets, however. Their easy availability could lead to another problem. Might not an oversupply in firepower induce commanders to employ too much of it – with grave consequences in terms of collateral damage? And collateral damage is highly counterproductive in typical peacemaking or peace-supporting efforts.

More artillery or more armor: a question of purpose

Modern intervention forces are geared to travel light. Otherwise quick-reaction strategic mobility would be impossible. Strategic mobility often goes together with the capability to swiftly move in a theater, in other words: operationally. Good operational mobility is required for wide-area patrol (and control) missions, as well as for far-reaching pursuit.

Because mobility is so vital, light forces have become center-stage assets. But even in contemporary scenarios light troops may need some kind of a more substantial back-up, or spearhead, if the going gets tough. In this context the question is: what should play a more prominent role: armor or artillery?[4]

Let us first examine the particular characteristics of armor, in other words main battle tanks accompanied by platforms for immediate support. Armor has been quite successfully employed in flexible positional warfare, as was demonstrated by two Israeli brigades defending the Golan Heights against the Syrian onslaught in the October War of 1973. To most proponents of armored warfare, however, this constituted an abuse. According to them such forces should preferably be employed in a manner that makes the best use of their true talents to dynamically affect the correlation of forces.

This suggests that armored forces, be it in deeply-penetrating breakthrough operations, in bypassing marches of long reach or in concentrated counterattacks against the flanks of an invader, excels other force elements in their ability to change the course of events. *Edward A. Shils*, the American military sociologist and theorist, spoke in this context of a dramatic, "theatrical" function often outweighing the actual fighting value of armor as a mere accumulation of mobile platforms.

When armor comes rumbling along, when it exerts shock power, it appears to be highly aggressive and provocative. This may be appropriate for missions aiming at the conquest of territory or the repulsion of an invader. But in scenarios of peace support with only small and distributed pockets of resistance, the use of armor in a concentrated, shock-type mode is likely to be counterproductive. It can easily send the wrong signal and may provoke additional violence.

And this problem could be aggravated by the fact that armor typically arrives on the scene a considerable time after the initial violence. In a region with skirmishes and terrorist activities flaring up here and there, it is near-impossible to have heavy armored forces always waiting around the corner. And when they arrive with a delay, they may further exasperate an escalatory process already underway.

Let us now take a look at the role of the artillery in modern intervention scenarios. On the one hand it is still very much a supporting arm when it serves as a complement to armor in dynamic operations. Sometimes it may act as a penetration aid when breakthrough attempts are made and sometimes it may fire barrages for the protection of the flanks of mobile columns.

[4] When we say 'armor' we do not accept the notion that the tactical functions of hitherto heavy shock forces can be totally taken over by a high-tech, light- or medium-weight future combat system like the one the Americans are committed to developing. Likewise we reject the notion that a network-based array of diverse assets of fire can wholly substitute for artillery.

On the other hand, we see the emancipation of the artillery as a genuine fighting arm. Based on optimal organic intelligence about relevant crisis spots (we remember that it has its own information system) artillery can react with almost no delay and, if need be, on its own. Wide areas can be covered without having to move around complex platforms and their logistical tail. Artillery ammunitions have become increasingly accurate; flexible concentrations of fire as well as the fine-tuning of its effects are ever more possible. No longer is it only stationary targets, such as terrorist strongholds, that can be dealt with effectively, but also mobile ones can now be hit with high and still rising chances of success.

Furthermore artillery action can be regarded as considerably less provocative than the massive use of armor. No rumbling monsters are spreading shock, fear and anger among civilians, but certain targets are taken out, ideally in a surgical manner and with very limited collateral damage. Such an approach to the use of heavy fire power appears to fit in better than a show of brute force with missions of creating and stabilizing peace.

It is true that the artillery can act in a stand-alone manner – a quality giving this force component additional tactical usefulness. Normally though, peace-related missions, which tend to be highly complex, see light troops with or without armor protection in the line of first contact. They march faster than heavy armor, enjoy a wider spectrum of options relevant to scenarios of insurgency, can be – for reasons of relatively low cost - held in larger quantity, and are easier to spread out for immediate (re)action. It is mainly with such forces that modern artillery must interact with in crisis situations.

It should be stated clearly, however, that even in the context of military interventions for stabilization there remains a vital role for heavy armor such as in rescue/evacuation missions requiring the heaviest of protection. The U.S. military may have learned this lesson painfully in Somalia in 1993.

Tube or rocket artillery: rational choice

When it comes to the choice as to what kind of artillery should be given to intervention forces, there are expert voices proposing a more generous use of rocket artillery.[5] Their list of supporting arguments follows:

- Modern mechanized rocket systems are not heavier than middle-weight tube artillery. The original American MLRS, for example, is in the same weight class as the old M-109 howitzer. (And there are several types of standard mechanized tube artillery – in Britain, France, Germany, Russia etc. – which are considerably heavier.) Interestingly, the U.S. Army has introduced a lighter version of the MLRS, the HIMARS (HIgh Mobility Artillery Rocket System), which weighs only 15 metric tons and carries the same missiles as the original launcher, but only half the number. All this suggests that rocket artillery

[5] see Alaa El Din Abdel Meguid Darwish, “Artillery, Rocket and Missile,” in: T. N. Dupuy (ed.), International Military and Defense Encyclopedia, Washington D.C.: Brassey’s (US) (1993) pp. 281-287.

systems are more suited for strategic transport by airlift than mechanized tube artillery.

- The relatively low weight of rocket launchers, the HIMARS in particular, and the absence of recoil when the missiles are fired have made it possible to base such systems on wheeled platforms. In the case of the HIMARS the platform is a very lightly protected 6x6-truck with reasonable cross-country performance. This enhances the systems' operational mobility which, in turn, improves fire allocation by adding to the system's effective operational range which is already quite impressive based on the missile range alone.

- Current MLRS missiles can cover roughly the same distance as a standard howitzer (155 mm), with a long barrel and firing "base-bleed" projectiles. However, the MLRS range of about 40 km has recently been extended to ca. 70 km. The first phase of the missile's flight is ballistic, while the second is aerodynamic. This means that if counter-battery radar only manages to detect the second phase it is impossible to determine the location of the firing unit from projection of the flight path,

- In the days of the Cold War rocket artillery systems were meant to deal with avalanches of armor coming at one's positions. It was intended to fire large salvos of rockets into the enemy's avenues of advance with the warheads carrying minelets and bomblets (the latter designed for top attack.) Although there were costly attempts to develop warheads with terminal guidance, the emphasis clearly lay on the rather indiscriminate application of massive firepower. When the integration of MLR batteries into modern expedition packages got onto the agenda this history became a drawback, as most intervention scenarios require a fine-tuning of firepower rather than its abundant use. But this legacy is over now. New generations of missiles for MLRS/HIMARS, and probably other systems, are going to have a GPS linkage providing relatively inexpensive precision guidance (the launch vehicles do have GPS navigation anyway.)

Advocates of prominent employment of tube artillery in expeditionary forces are not convinced by these arguments for the advantages of rocket artillery with respect to mobility, range of fire and accuracy. They point to the fact that there have been promising developments of mechanized guns in the middle or lower weight categories, some even on wheeled platforms, that compare well with rocket artillery in regards to strategic and operational mobility.

Because the quality of information deteriorates with distance, they do not see much of a tactical advantage for rocket artillery in ranges considerably over 40 km. They point out that significant range extensions for tube artillery are feasible as well -- namely through Rocket Assisted Propulsion (RAP), but would readily concede that this would still imply a ballistic, and therefore measurable, flight path. And with respect to accuracy they might stress that GPS is, in principle, jammable and that tube artillery has for "natural" (physical) reasons a significantly smaller CEP than rocket systems: a quality which is an excellent precondition for the development of cost-effective terminal guidance.

Apart from that there are four critical observations which all suggest that rocket artillery has deficits in tactical flexibility:

- Rocket artillery cannot fire at point-blank ranges. Furthermore, there is an inner radius of up to 10 km within which an MLRS or HIMARS (or similar rocket launchers) are unable to serve targets. Tube artillery has no such limitations.

- MLR systems were invented to produce dense volleys of fire – something tube artillery can only achieve by the simultaneous action of whole batteries. But the reloading procedure of modern guns is a lot quicker. Guns can fire several shells a minute and can be fired in a manner so that several rounds strike the same target at the very same time. The recharging of an MLR system may take up to half an hour.

- While guns can easily fire a broad spectrum of shell types, rocket artillery normally has a more limited number of different warheads. Warheads, which are not within the weight and shape parameters of the original rocket design, may negatively affect the flight characteristics (including the accuracy) of the missile. This limitation applies especially to rockets which are spin-stabilized: something quite common among modern designs.

- Missile packages for MLR systems tend to be very bulky and thereby create logistical problems exceeding the ones experienced with tube artillery.

State-of-the-art guns: systematic comparison

The argumentation in favor of mechanized tube artillery as an integral element of intervention forces will be rounded off by a presentation and systematic comparison of typical examples of modern mechanized guns of the lighter variety. In our small sample there are three novelties: the French system CAESAR (CAmion Equipé d'un Système de l'ARtillerie), the German AGM (Artillerie-Geschütz-Modul) and the Slovak ZUZANA ("Susan").

All three systems are able to travel by air. The lightest one, the French, which by the way is in the weight class of HIMARS or a mortar on a modern armored personnel carrier, can be lifted by a C-130, the most common military transport plane in the Western world. The other two systems require aircraft in the upper medium-weight category – with about 30 metric tons payload or more, such as the Ukrainian Antonov 70 or the European A-400M (currently under development.) Of course, the giant transporters of our time, C-5, C-17 or Antonov 124, could each fly several of the artillery pieces in question. All three systems do have very capable, long-range guns. Reloading is very quick: 6-8 rounds can be fired in a minute. Furthermore the systems' reaction time – into position, fire and leave – is extremely short and more than a match for mortars.

Profile	**CAESAR**	**AGM**	**ZUZANA**
Country of origin	France	Germany	Slovakia
Combat weight, metric tons	17.7	27	28
Type of platform	wheeled (6x6)	tracked	wheeled (8x8)
Crew, incl. driver	6	2	4
Caliber (mm)/ length of tube (cal)	155/52	155/52	155/52
Max. range of fire	40	40	39
Combat load, shells/charges	18	30	40
Loader fully automatic	no	yes	yes
Rounds per minute (sustained)	6	8	6
From the march to first shot (minutes)	<2	0.5	<2
Leaving the position (minutes)	<1	0.5	1
Crew protection	very partial	all-round	partial

Sources: Martin Pöpel, own research (L. U.)

The French CAESAR uses a six-wheeled truck of commercial make with cross-country performance (Renault). It is a very simple, low-cost design, and, due to the lack of automation, relatively personnel-intensive. There is very limited crew protection: only on the march, when the soldiers sit in the frontal cabin, but not during the fire fight. Although the gun is stabilized by hydraulic “stilts” when in position, it can only fire forward with no more than 15° deviation to both sides. Apparently, in the case of this system a number of potential qualities have been traded for low cost, ruggedness and strategic as well as operational mobility.

At 27 metric tons the German AGM is a relatively light-weight derivative of the Panzerhaubitze (armored howitzer) 2000 which has 55.5 tons and is considered the world’s most capable mobile, protected artillery piece. Due to its high degree of automation the AGM can be operated by only two soldiers. Among the guns compared here, its reaction time is the shortest. As the system rides on an adaptation of the MLRS platform, there are logistical advantages. The platform being tracked, the gun does not need any additional stabilization and can fire 360°. Being tracked the vehicle does not enjoy the same operational – in-theater – mobility as the other two types. Instead it excels in tactical mobility and crew protection. Crew protection is notably “all-round”: against standard mines, shell fragments, small-arms fire, against top attack and NBC threat – in position and on the march.

The Slovak ZUZANA travels on the chassis of a heavy-duty commercial truck with eight wheels (TATRA 815). Although the initial development dates back to communist times, the model as it is now is a thoroughly modern design that fully meets NATO standards. In an overall rating of its performance and other relevant data it could be placed between the other two systems. It is particularly noteworthy that it excels in operational mobility and probably costs considerably less than the German model.

We have seen that in the case of the French system some qualities other models possess were traded for strategic and operational mobility. The U.S. Army has driven this to the extreme in its plans to modernize traditional field artillery: something that would appear rather bizarre in good ’old‘ Europe. It is as if one were attempting to combine the mobility of the mortar with the performance of modern standard artillery.

The Army is in the process of introducing its new field howitzer M777, to be towed by light, unprotected trucks. With a weight of only 4.5 metric tons, the system may claim excellent strategic mobility. And its operational mobility can be outstanding too: but only if the gun, the crew, ammunition and its navigation cum fire-management module are transported by heavy-lift helicopter. This is possible, but rather a costly undertaking. Otherwise the system has the mobility of World War II motorized artillery which was not particularly impressive.

As for the profile of tactical performance, the howitzer by no means measures up to our examples of modern mechanized artillery. The caliber is the same, namely 155 mm, but the barrel is shorter (39 cal. instead of 52) which translates into a maximum range of only 25 km. There is no ammunition carried directly at the gun. Only four rounds per minute can be fired. It takes three minutes to get ready to fire, and two to leave one’s position. (All our mechanized systems are significantly quicker.)

As many as seven soldiers are needed to operate and move the whole arrangement, which is quite problematic in times of personnel shortage. There is no armor

protection whatsoever --as if one were not planning for non-linear contingencies (for missions in civil wars or those affected by insurgent resistance) characterized by threats out of the blue and from all directions leaving no relatively 'safe rear' for the artillery.

In other words, what this new piece of American ordnance clearly lacks is balance. ***If one intends to trade tactical performance for strategic mobility, one should not go further than the French Army, and not totally give up the idea of mechanization. Vive la France!***

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