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United States Marine Corps
Command and Staff College
Marine Corps University
2076 South Street
Marine Corps Combat Development Command
Quantico, Virginia 22134-5068

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AUTHOR:

CPT Matthew Van Arsdale
United States Army

AY 2019-20

Mentor and Oral Defense Committee Member: J.W. Gordon

Approved: [Signature]

Date: 14 April 2020

Oral Defense Committee Member: LTCol Brad Pennella USMC [Signature]

Approved: [Signature]

Date: 14 April 2020

*United States Marine Corps
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Marine Corps University
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EXECUTIVE SUMMARY

Title: The King of Battle versus the God of War: Reorganizing and Equipping US Army Artillery formations to defeat peer competitors

Author: CPT Matthew Van Arsdale, United States Army

Thesis: The Russian Army has refocused and modernized its tactical formations around a robust Strike Complex which outranges, outguns, and is more efficiently organized than US Army Artillery formations. The US Army must modernize its artillery forces and restructure the Division Artillery formation to compete and defeat current threats in Large Scale Ground Combat Operations.

Discussion: Russian military formations have undergone significant modernization in the past ten years, upgrading equipment, adding capabilities, and reorganizing formations. The Russian fire support system and strike complex has seen some of the most dramatic upgrades during that time period, including the addition of new weapon systems and launchers, battlefield surveillance equipment, and electronic warfare assets. The focus on a robust strike complex, while not a new development for the Russian military, has provided Russian forces a set of capabilities that significantly over-matches US capabilities at the brigade and lower levels. Facing these new capabilities and organizations will put US Brigade Combat Teams (BCTs) at a significant disadvantage.

Conclusion: To provide tactical overmatch, flexibility, and survivability on the battlefield, the US Army must re-equip and reorganize its artillery formations at the Division level. Rebuilding and restructuring the Division Artillery (DIVARTY) echelon will provide Divisions and brigades the ability to locate and target enemy forces on the battlefield more effectively and efficiently.

“With respect to Russia...we are outranged, outgunned on the ground.”

- GEN Mark A. Milley, Chief of Staff of the US Army¹

Introduction

Currently, the US Army field artillery assets at the division and Brigade Combat Team (BCT) are outranged and outnumbered by Russian forces of similar size, and have significantly fewer target acquisition assets than Russian counterparts. Additionally, the organization of the Russian Strike Complex ties observation equipment, including UAVs, radars, and EW systems, directly to artillery formations, providing fires that are much faster and more responsive than US formations. These factors have created a distinct advantage for Russian ground commanders in the Fires Warfighting Function. The US Army must modernize its artillery forces and restructure the Division Artillery formation to defeat current threats, compete, and win during Large Scale Ground Combat Operations.

In early August, 2008 the Russian Federation launched an overwhelming assault on Georgia, annexing territory and crushing the Georgian armed forces. Despite the successes of the Russian forces, the Russian high command sought to improve their military force. Over the next few months the Russian Ministry of Defense developed a plan for a series of sweeping changes that would overhaul the Russian military, with specific emphasis on ground forces. These modernization efforts capitalized on the lessons learned from the two Chechen conflicts and the invasion of Georgia, where Russian ground forces learned the importance of target acquisition assets, electronic warfare systems, and overwhelming long-range firepower. After these efforts, Russian forces became more agile, flexible, and deadly, increasing the numbers of artillery systems and vastly improving battlefield surveillance capabilities. These reorganized and reequipped formations were highly effective during combat operations in eastern Ukraine in

2014. The newly developed Russian capabilities were highlighted during an artillery strike in July of 2014, when two Ukrainian mechanized battalions were made combat ineffective during a single artillery strike. The Ukrainian forces were located through electronic warfare (EW) assets, locations confirmed by an unmanned aerial vehicle (UAV), and struck by rocket and cannon forces within approximately fourteen minutes of detection by the EW assets.² This strike demonstrated that the Russian ground forces were still willing and capable of employing massed artillery fires against enemy formations, in contrast to the small volume and precise strikes preferred by US forces. The strike also demonstrated the range overmatch that the Russian ground forces had developed, as the strikes came from outside the range of any US artillery system assigned to BCTs or divisions.

Methodology. Russia was chosen as the case study because of the US Army and Department of Defense's emphasis on Russia as a great power competitor and as a pacing threat for US force design and modernization.^{3,4} This paper will look at the modernization efforts the Russians undertook and the reorganization of their ground forces, focusing on the Battalion Tactical Groups (BTGs) and Brigades. This paper will then compare these Russian formations with current US formations and equipment before finishing with a proposed solution. This paper looks at both the Russian BTG and brigade while comparing the capabilities of a US Brigade Combat Team (BCT), unlike many papers that have only focused on the BTG.⁵ This expanded analysis is conducted because US formations will most likely not be able to achieve the desired force ratio, or be able to only engage a unit one echelon smaller, during combat operations. Russia is capable of fielding more brigade sized formations than the US and its NATO allies, leading to the distinct possibility that a US BCT will be required to engage two BTGs or one Russian brigade at one time.⁶

The Division Artillery formation was selected as the focus of proposed US Army modernization efforts due to the flexibility of the proposed organization and the US Army's reemphasis of the Division as the primary tactical formation. The Division Artillery (DIVARTY) element is a direct support formation that coordinates field artillery operations for a maneuver division. A standard component of US Army Divisions since World War I, the DIVARTY formation was removed from all divisions in 2006 during force restructuring in support of stability and counterinsurgency operations.⁷ Currently, each of the US Army's ten active divisions contains a DIVARTY, but these formations are headquarters only and do not contain any firing batteries, logistics units, or observation capabilities. Reorganizing these formations will provide the division flexibility and more capable fire support for Large Scale Ground Combat Operations.

The Russian Threat

Modernizing the Force. The Russian military has undergone three major reforms and restructuring initiatives since the collapse of the Soviet Union in December of 1991.⁸ Each of the three reforms were primarily driven by different factors; political, economic, and lessons learned from combat. The first major reform occurred in the early to mid-1990s under Boris Yeltsin and saw the contraction of Russian military forces from 5,000,000 uniformed members to less than 2,000,000.⁹ Simultaneously, the budget for the army was drastically cut. This reform was driven by the collapse of the Soviet Union and the lack of a need for such a massive military organization. While the Russian government decreased the number of personnel within the army, the number of units at the brigade and division level remained relatively stable.¹⁰ The reduction in personnel produced a 'hollow' army that had multiple division sized units that were

less than 30% manned.¹¹ The reduced budget produced an army that lacked new equipment, funds for training, and maintenance capabilities.

In December 1994, this depleted force was ordered into Chechnya to prevent an Islamic succession of the region.¹² While Russian forces were able to muster and deploy a sizeable force, after two years of intense fighting in Chechnya, the army was withdrawn without achieving its objectives. The first Chechnyan war was viewed as a tactical and strategic defeat for the Russian army and Russian Federation. With this defeat in mind and a looming economic downturn in Russia, the government looked at a second set of army reforms.¹³

Driven by the need to reduce defense budgets, the number of brigade sized units in the army was reduced from 2,134 to 1,890.¹⁴ While the number of units was greatly reduced, the army was still grossly undermanned, often only fielding 30-35% of required personnel in each unit. The reduction in end strength enabled more funds to be applied to training, maintenance, and equipment upgrades. While the Russian army remained undermanned, it was considerably more proficient than the army that deployed to Chechnya in 1994. This would be demonstrated in 1999, when Islamic separatists from Chechnya invaded the Russian province of Dagestan.

After initial delays, the Russian Army mobilized four brigades and swiftly crushed the separatist fighters and was subsequently used as the pretense to conduct a second campaign within Chechnya.¹⁵ This second campaign was executed with a much higher level of competence and confidence by the Russian army, pacifying the province and cementing Russian control over the region. While a low-level insurgency continued in the region until 2009, the Russian army viewed the operation as a resounding success, justifying earlier reforms.

In August of 2008, Russian armed forces massed along the border of Georgia and within the Georgian provinces of South Ossetia and Abkhazia in support of pro-Russian separatists

within the region.¹⁶ As the situation deteriorated and Georgia attempted to forcefully retain its control over the region, Russian armed forces launched a swift four day assault that devastated the Georgian military.¹⁷ The attack demonstrated new Russian capabilities such as cyber warfare, but more importantly demonstrated a proficiency and competence not seen in the Chechen conflicts. Despite the overwhelming success of the Georgian offensive the Russian military went through the third major military reform since the collapse of the Soviet Union.

The 2008 military reforms were known as the “New Look” reforms and represented the most drastic changes the Russian military had undergone since the end of the Cold War. These “New Look” reforms drove military reorganization at almost every echelon from the strategic level down to tactical formations.¹⁸ The reforms started with a reorganization of the high command structure and ministry of defense, streamlining the organization by eliminating over half of the general officer positions within the military. The reforms continued by reorganizing the Russian military’s strategic operational commands, consolidating from six regional commands into four commands.¹⁹ The most drastic aspects of the “New Look” reforms took place at the tactical organizations of the army. With the exception of the airborne forces, the division and regiment were eliminated as echelons within established the army and established the brigade as the primary tactical unit. This shift was made to make rapid deployments easier and more responsive throughout the four strategic operational commands.²⁰

Russian brigades are analogous to US Army Brigade Combat teams, forming a self-supporting combined arms formation comprised of approximately 3,500-4,500 soldiers, much smaller than legacy regimental and division formations.²¹ The smaller size and self-supporting nature of the “New Look” brigades facilitate the Russian need for quickly mobilized and deployable forces in support of limited scale conflicts on the perimeter of Russian territory and

spheres of influence. In addition to eliminating the division and regimental formations, Russia again reduced its number of large formations (brigades and above) from 1,890 to 172.²² The reduction in large formations and overall number of formations has enabled the Russian army to focus efforts on manning, equipping, training, and deploying highly proficient and capable forces.

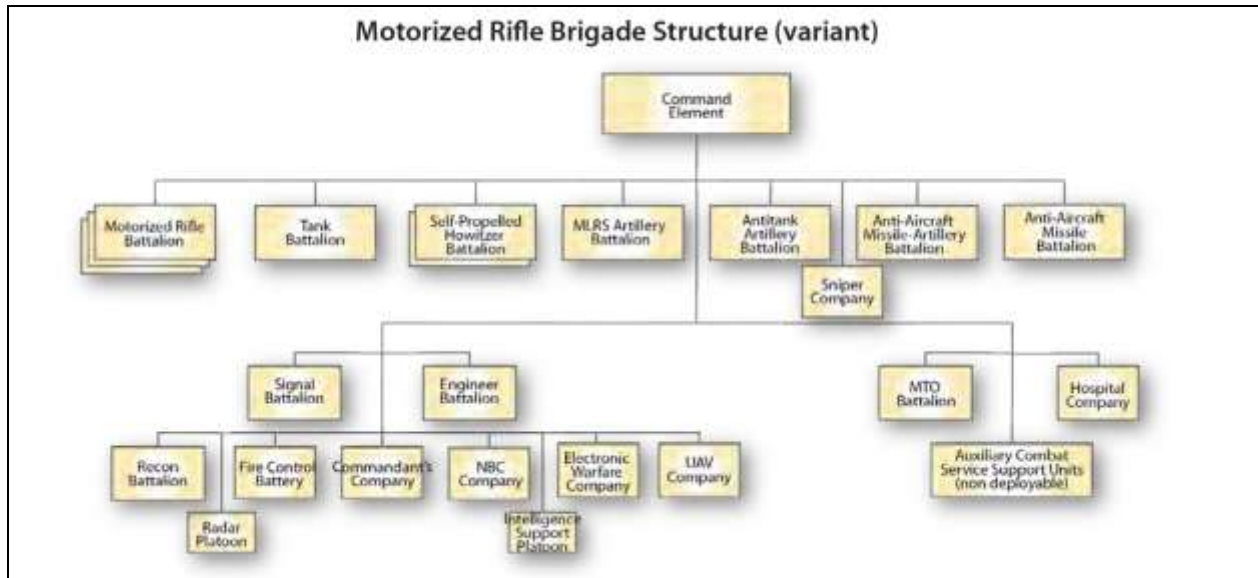
The reduction in forces reflects Russia's changing attitudes on what its military needs to accomplish and the types of conflicts that the Russian military must be prepared to fight. Russia still views large scale conflict with the United States as the primary threat to its sovereignty and continued existence, and dedicates most training resources to this task.²³ While large scale ground combat is the most pressing threat, the Russian Ministry of Defense has increased its focus on limited scale conflicts. These limited scale conflicts cover a wide range of operations, from ensuring territorial integrity (Chechen Wars) and countering invasions (operations in Dagestan) to protecting ethnic Russians (Crimea and Ukraine) and bolstering regional allies (Syria).²⁴ Rapid, independent, and capable formations are ideal for these conflicts, providing the Russian government cost effective and flexible options for deploying forces.

Tactical Formations. The two predominant formations utilized by the Russian army during operations are the combined arms brigade and the battalion tactical group (BTG). These formations are task organized to be self-supporting for short durations of combat, containing robust fires, logistics, electronic warfare, and protection assets. Combined arms brigades within the Russian army are permanent organizations assigned directly to army groups and the strategic operational commands.²⁵ Battalion Tactical Groups are ad hoc formations created and task organized by brigades and comprised of brigade assets. With the exception of a small number of

airborne regiments, a majority of operations within Georgia, Ukraine, and Syria have been conducted by brigades and BTGs.²⁶

Brigades: The Russian army has four general types of combined arms brigades; light infantry, motorized, mechanized, and armored. Russian army brigades are organized similarly to US Army Brigade Combat Teams (BCT) but contain a disproportionately higher number of support organizations within their structure. Russian brigades contain four maneuver battalions (equipped based on brigade type), five artillery battalions (two howitzer, one rocket, and two air defense battalions), one anti-tank battalion, one recon battalion, one engineering battalion, one signal battalion, and a logistics battalion.²⁷ The brigade also contains robust Unmanned Aerial Vehicle (UAV), electronic warfare (EW), chemical warfare, and sniper capabilities (see fig. 1). Brigades also include a Fire Control Battery, containing a fire support coordination element, survey platoon, counterfire radar platoon, and two reconnaissance platoons. Additionally, each mechanized and motorized battalion contains a mortar battery consisting of eight 120mm self-propelled or towed mortars while each company is supported by three 60mm mortars for close range support.²⁸ The wide array of capabilities available to brigade commanders enable a brigade sized element to conduct independent operations for short durations of time without higher echelons attaching or assigning additional capabilities. The higher number of support assets also support the Russian concept of fighting as a fires centric force, not a maneuver warfare centric force.

Figure 1:²⁹

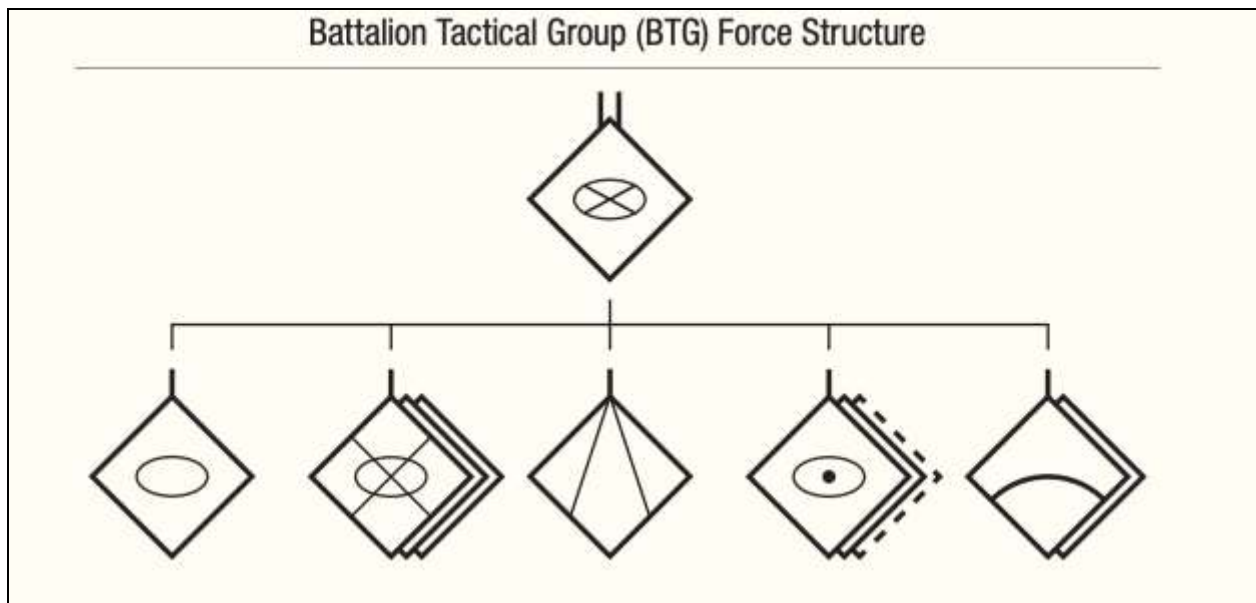


Battalion Tactical Groups: The Russian Battalion Tactical Group (BTG) is not a permanent organization within the Russian army, but an ad hoc formation task organized and formed for specific missions.³⁰ The Russian army has utilized this technique of task organizing for decades, with plenty historical examples of BTGs operating within Afghanistan and Eastern Europe throughout the 1960s and 1970s.³¹ Task organizing the BTG in support of specific missions enables the Brigade or Army group commander the flexibility to tailor the force to meet the needs of the mission. In addition, the smaller size of the BTG enables rapid deployment with a limited logistics train. The successful use of the BTG in areas of operation such as Chechnya, Georgia, Ukraine, and Syria have led the Russian high command to dictate that each combined arms brigade will have two BTGs fully manned, equipped, and trained for operations at all times. Additionally, the Russian Ministry of Defense has stated the Russian army will expand the number of ready BTGs to 125 by 2018.³² Because the BTG is still not a permanent organization it is difficult to assess if that goal has been met.

Despite the fact that no official organizational structure for the BTG exists, most of these formations share several characteristics. BTGs are formed with a command element, four

maneuver companies (one tank and three mechanized or motorized), three artillery batteries (two howitzer and one rocket), one anti-tank company, and two air defense companies (see fig. 2).³³ While these are the basic ‘building blocks’ of the BTG, brigade commanders are able to add additional capabilities depending on the mission set. BTGs operating along the Ukrainian border have deployed with additional recon, rocket artillery, radar, logistics, and EW assets.³⁴ BTGs operating in Syria have been observed with additional rocket artillery, air defense, engineering, and sniper capabilities.³⁵ The BTG is designed to conduct independent operations when augmented and supported by higher elements’ logistics assets and formations. The large amount of fires assets task organized to the BTG provide a much larger fires capability than comparably sized formations in Western armies.

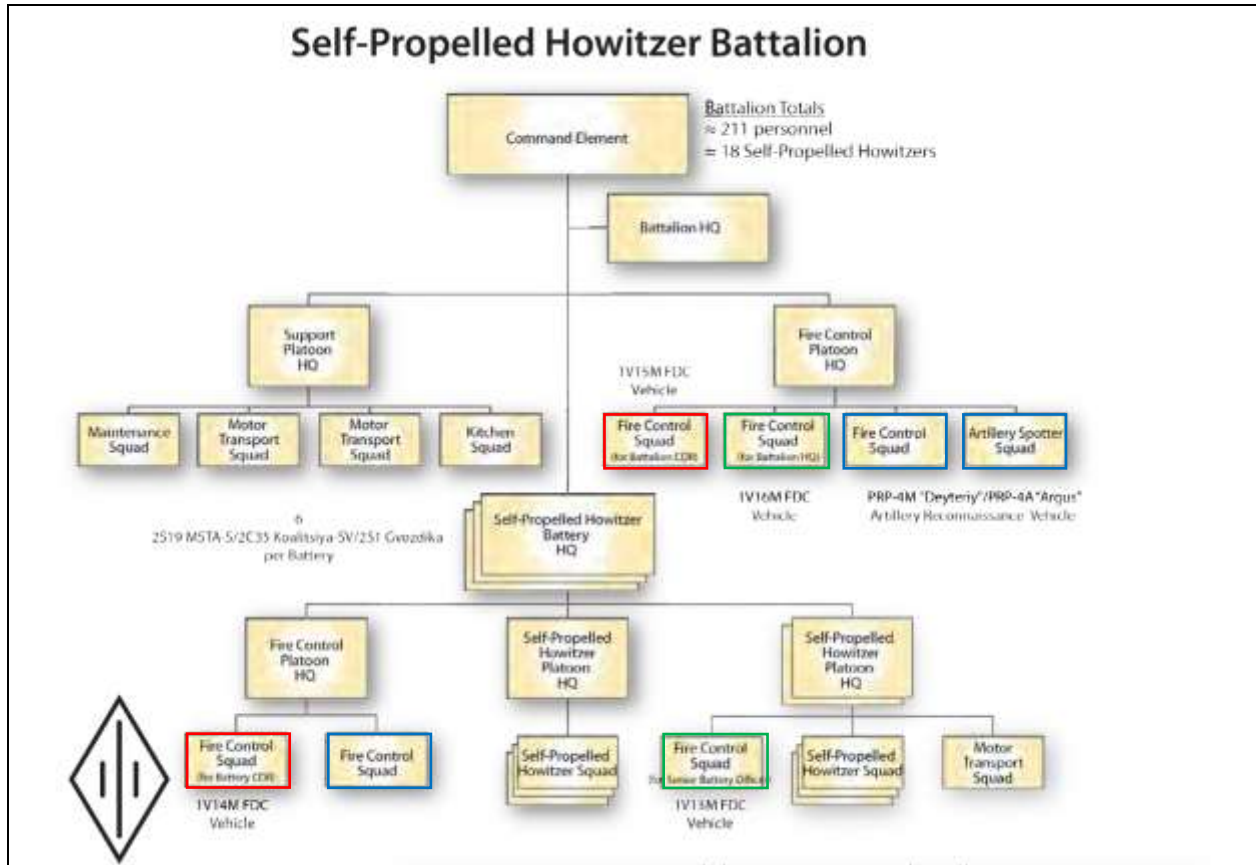
Figure 2:³⁶



Artillery Formations: Russian howitzer and rocket battalions and batteries are organized similarly to their US military counterparts with the exception of the brigade’s fire control battery and the fire control centers found at the battalion and battery.

Howitzer battalions are comprised of three firing batteries of six guns, a support platoon for maintenance and ammunition transportation, and a fire control platoon (see fig. 3).

Figure 3:³⁷

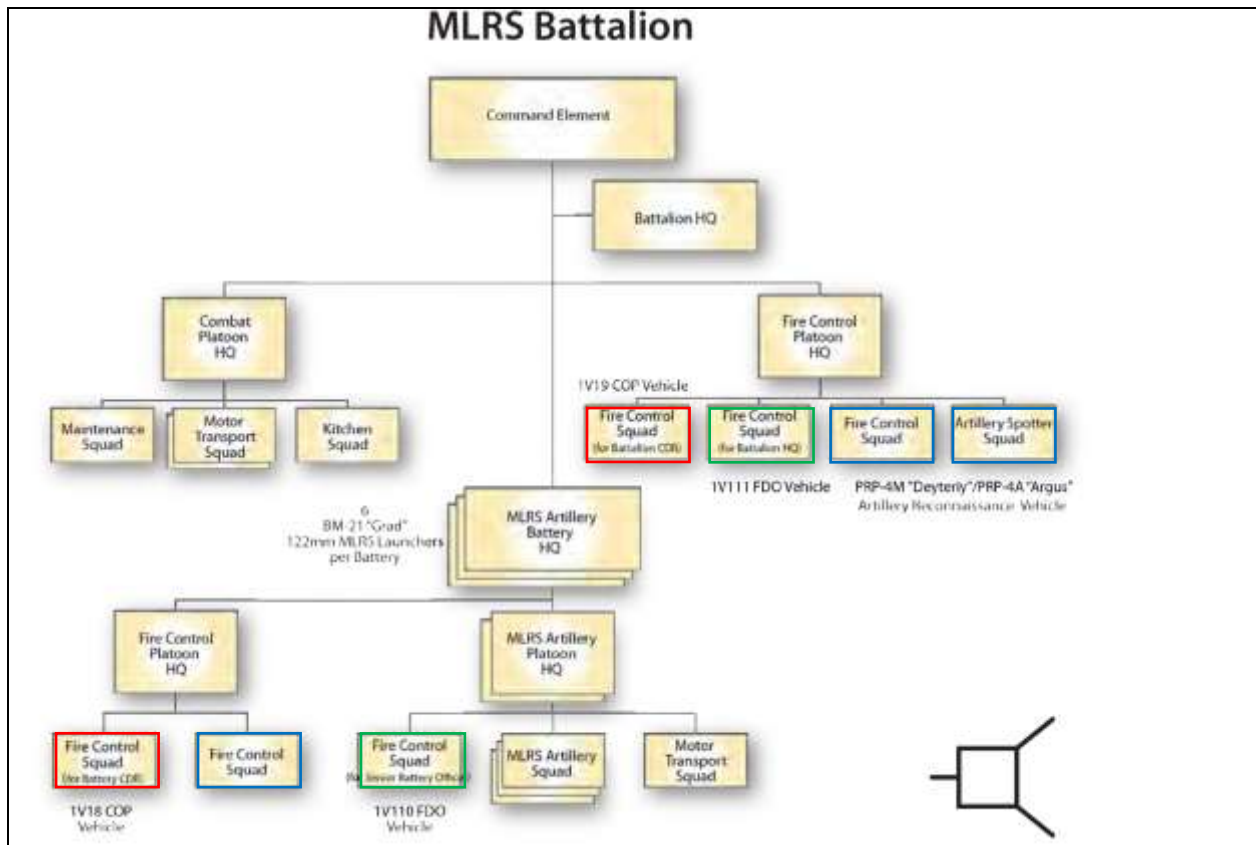


Similar to US Army howitzer batteries, Russian guns are organized into two platoons of three guns each. The primary difference between US and Russian artillery structure is in the command and control elements. Russian artillery formations use three types of fire control squads which serve the functions of forward observers, tactical fire control, and technical fire control. Within each howitzer battalion and battery's headquarters platoon is a fire control squad equipped to operate as forward observers (these elements are outlined in blue within figure 3).³⁸ Forward observer equipped fire control squads and artillery spotter squads are capable of establishing mounted and dismounted observation posts and transmit requests for fire to the

tactical fire control elements. Tactical fire control within the Russian army is executed by the artillery battalion and battery commanders (outlined in red within figure 3) in squads and vehicles described as the Command Observation Post (COP). Artillery commanders are responsible for developing fires plans as well as clearing and prioritizing fires. The COPs are often collocated with the maneuver commanders to facilitate operations and fire support. Commanders will route the approved and prioritized fire mission orders from the COP to the technical fire direction centers located at the battalion and battery. The technical fire direction centers (outlined in green within figure 3) calculate firing solutions and manage ammunition expenditure.³⁹

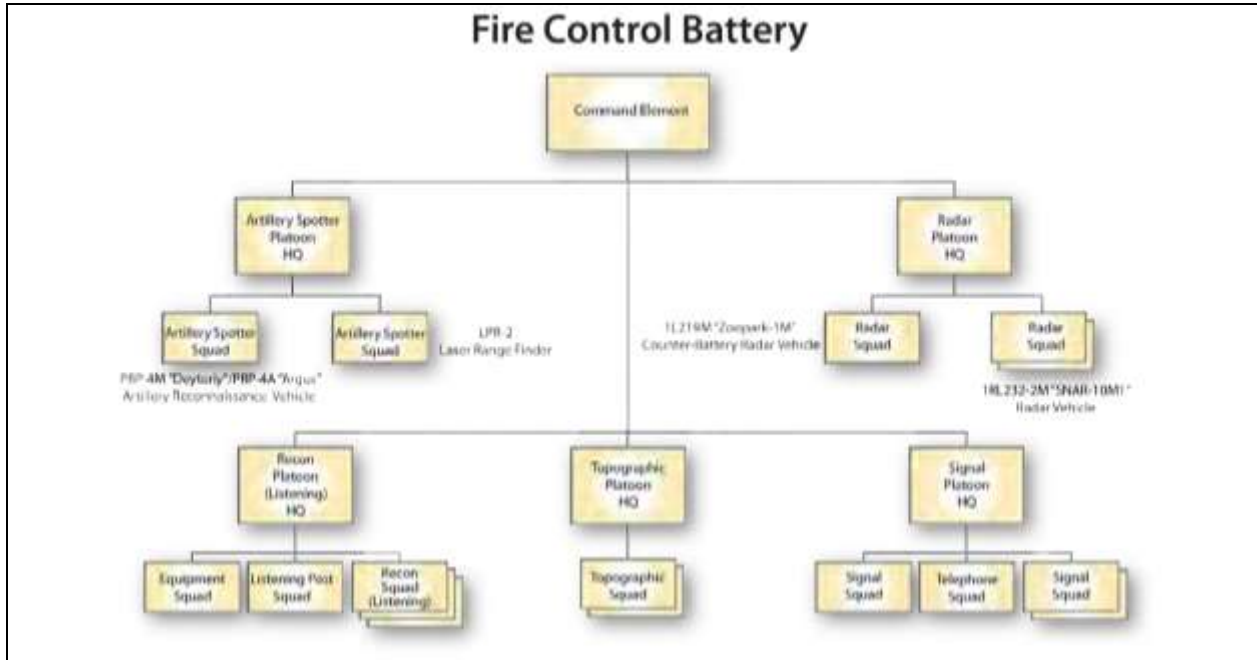
Multiple Launch Rocket System (MLRS) or rocket battalions follow the same organizational structure as howitzer battalions. Rocket battalions are divided into three batteries that contain six rocket launchers, logistics elements, and fire control squads (see figure 4).⁴⁰ Observation, tactical, and technical fire direction are executed and conducted in the same way that howitzer battalions operate.⁴¹ Figure 4 shows the layout of observers (blue outlines), tactical fire direction centers in the form of COPs (outlined in red), and technical fire direction centers (outlined in green). Unlike US Army rocket formations, Russian rocket battalions have organic forward observers in support of rocket fires.

Figure 4:⁴²



Brigades are also manned and equipped with a fire control battery (see figure 5). The fire control battery is an artillery support organization that includes radar, observation, reconnaissance, and survey capabilities. The fire control battery's radar capabilities include counterfire, ground sensing, and aerial warning radars.⁴³ Observation and reconnaissance elements utilize both visual observation as well as electronic and signals 'listening' observation elements. The observation and radar elements are linked directly to the artillery COPs at the battalion or battery level and provide rapid observation in support of fire missions. The signal elements of the fire control battery provide the brigade's artillery elements dedicated retransmission and communication support, facilitating fire control nets without support from the brigade's signal battalion.⁴⁴ Lastly, the fire control battery's topographical support platoon provides survey support to radar systems, observers, howitzer formations, and rocket elements for accurate positioning.

Figure 5⁴⁵:



The organization of Russian army brigades and the task organization of BTGs reflects the Russian preference for utilizing overwhelming long-range fire power to facilitate mission accomplishment. The high number of artillery assets coupled with advanced EW capabilities, multiple radar systems, and UAV support enable the Russian army to effectively locate, target, and destroy enemy formations.

Equipment

In addition to organizational improvements and modernization, the Russian army has also undergone a massive series of equipment modernization programs since the 2008 invasion of Georgia. Utilizing lessons learned from the Georgian conflict the Russian army has concentrated its modernization efforts in several key areas, specifically electronic warfare capabilities, UAV systems, and communication systems.⁴⁶ While EW, UAV, and communications equipment have seen the most radical modernization efforts, the Russian army has also been improving its combat vehicles, artillery delivery systems, and observer equipment.⁴⁷ Outside of EW and UAV

equipment, Russia's approach to modernization is incremental, improving most systems one component at a time. The BM-21 GRAD MLRS exemplifies this tendency for incremental improvements. Designed and fielded in the early 1960s, the BM-21 is still the primary MLRS launcher within maneuver brigades and artillery battalions. Improvements have been made to munitions, reloading mechanisms, and communication systems, but the launcher remains basically the same piece of equipment that was first employed in combat by the Russians during 1969 border conflicts with China.⁴⁸

Delivery systems. Cannon systems remain the most common form of artillery within the Russian army, utilizing a variety of towed and self-propelled systems in support of maneuver forces. While the Russian army still has multiple brigades of towed artillery, the military is modernizing and moving to an all self-propelled howitzer force. The primary self-propelled howitzer of front-line units is the 2S19 MSTA-S, a 152mm tracked howitzer. Since entering service in 1989, the 2S19 has seen significant upgrades and modifications. The most current version, the 2S19 MSTA-S, is capable of self-locating and self-laying, reducing emplacement time to less than 90 seconds. A digital gun aiming device facilitates rapid traverse and elevation of the gun tube and is able to receive digital fire missions from the fire direction center. Equipped with an autoloader the howitzer is capable of firing ten rounds per minute continuously and is able to load the tube at any elevation which provides a much higher rate of fire during high angle fire missions than US cannon systems.⁴⁹ With a turret capacity of 50 rounds and an integrated ammo resupply conveyor, the crew of five can theoretically keep the system in operation for extended periods of time with minimal down time for ammunition restocking. Current munitions enable the 2S19 to fire standard rounds out to 24 kilometers and rocket assisted projectiles to 36 kilometers.⁵⁰ Munition capabilities include high explosives (HE), dual-

purpose improved conventional munitions (DPICM), top attack anti-armor munitions, illumination, chemical, smoke, mine laying (FASCAM), thermobaric, incendiary, EW jamming, GPS and laser guided warheads, and tactical nuclear warheads.⁵¹ Modernization efforts continue to improve the 2S19's fire control system, protection systems, and communications equipment.⁵² The 2S19 provides the Russian brigade and BTG a direct support howitzer system that currently outranges US cannon artillery systems, is more mobile and protected than US towed systems, and has more capable munitions.

While a majority of artillery systems within Russian army are cannons, the Multiple Rocket Launcher (MRL) is growing in importance. The Russians employ an extremely diverse range of MRL systems, ranging from the Iskander-M tactical missile launcher with ranges exceeding 500 kilometers to the 122mm BM-21 GRAD at the tactical level.⁵³ The Russian army organizes its MRL formations into three general categories, strategic, army support, and tactical support. Strategic MRL forces are equipped with the Iskander-M and other extremely long-range systems, while the army support artillery brigades are equipped with the 300mm 9A52-2 SMERCH or 220mm 9P140 (often labelled BM-27) Uragan, while tactical artillery formations attached to maneuver brigades are primarily composed of BM-21 GRAD MRLs.⁵⁴ The BM-21 is a 122mm tube launched MRL mounted on a wheeled chassis capable of emplacing and displacing within five minutes. Capable of launching its 40-rocket payload in 20 seconds, the BM-21 is used extensively for mass barrages and area bombardments. Current munitions for the BM-21 provide ranges of approximately 40 kilometers. Munitions include high explosives, smoke, thermobaric rounds, mine laying, EW jamming, anti-tank, incendiary, chemical, and illumination capabilities. Modernization efforts to improve the BM-21 system have been focused on improving communications systems and adding GPS location equipment. While the

launch system has seen modernization efforts, improvements have been made primarily to the munitions.⁵⁵ The Russian army is also looking to finally replace the venerable BM-21 with the 9A52-4 Tornado. The Tornado has increased ranges as well as the ability to fire 122mm or 220mm rockets. The first Tornado MRLs entered Russian service in 2014 and have seen combat tours in Syria. The Tornado has upgraded communication, self-locating, and self-laying systems and is able to emplace in approximately two minutes. While the 122mm Tornado shares many of the same munitions as the BM-21 GRAD, the 220mm version has extended ranges out to 70 kilometers with conventional rockets and 120 kilometers with GPS guided munitions.⁵⁶

Russian formations may be augmented by additional fires assets from artillery brigades attached to army groups. These reinforcing battalions usually consist of the BM-27 Uragan or BM-30 Smerch MRL systems. The BM-27 Uragan is a 220mm MRL providing fires out to 70 kilometers, whereas the 300mm BM-30 Smerch MRL has conventional ranges of 90 kilometers. The BM-27 and BM-30 also provide additional capabilities, including EW jamming munitions, rocket launched UAVs, and cluster munitions.⁵⁷ Both the organic and reinforcing MRL assets provide the brigade and BTG commander a weapon system that greatly outranges current US Army BCT organic fires systems, providing advantages in counter battery operations and preparatory fires. The number of MRL systems organic to Russian maneuver units enable mass fires that have demonstrated considerable effectiveness against lightly armored targets.

Communication Systems. Operations during the defense of Dagestan and invasion of Georgia in 2008 revealed extensive weaknesses within the Russian army's communications systems. The "New Look" reforms subsequently placed a great deal of emphasis on improving and hardening communication systems utilized by Russian ground forces.⁵⁸ These modernization efforts focused on transitioning older radios to a completely digital communications infrastructure and

the development of networked command and control systems. Russia began replacing its older fleet of radios with advanced digital radios starting in 2010. Currently, Russian forces operate with systems capable of communicating over FM, HF, UHF, and VHF frequencies.

Transitioning to digital systems also enabled the development of advanced encryption technologies, such as cypher text and frequency hop capabilities.⁵⁹ Digital radios also allow for the transmission of data, including targeting and fire mission request data. The digital radios employed by the Russian army provide their forces extended communications ranges, more secure transmissions, and the ability to transmit data, facilitating faster and more effective coordination between units and supporting assets.

In addition to upgraded radios the Russian army has been developing new digital command and control systems to improve battlefield coordination, battlefield tracking, and situational awareness. Starting in 2015, the Russian army began development of the Andromeda system, a computerized common operational picture and unit tracking system that is analogous to the US Army's Force XXI Battle Command Brigade and Below (FBCB2 or "Blue Force Tracker") system.⁶⁰ The system provides maneuver and artillery commanders better real time data of friendly unit locations, and can receive requests for fire to coordinate artillery strikes. These systems have been fielded to the airborne brigades in the Western and Southern Military Districts and are starting to appear in mechanized units operating near the Ukrainian border.⁶¹ Additional digital command and control systems have been developed specifically for artillery formations and observers. Russia has been employing increasingly digital and sophisticated ballistic computation systems that can send and receive fire missions, mission status messages, and fire support coordination graphics. On the observer end of the artillery kill chain, the Russians have developed a hand held tablet computer capable of displaying friendly units and

graphics on satellite map overlays and can be used to call for artillery, air, or maneuver support. The system, known as Strelets or KRUS (an acronym for Reconnaissance, Command and Control, Communications System) enables a user to essentially point to a location on the tablet's map and the system will send a digitally formatted request for fire to the supporting artillery unit.⁶² The system is under initial development but has seen use in Syria and on the Ukrainian border during exercises. Future improvements include inertial navigation units for degraded operations, integration with aviation assets, live video feed monitoring from UAVs, and additional coordination functions.⁶³ These digital systems decrease the amount of time required for fire mission requests to be executed on unplanned targets, reducing the time friendly forces have to act and gain the initiative.

Observation systems. In order to effectively employ the considerable fires assets assigned to brigades and BTGs, the Russian army needed to improve its observation capabilities. Two factors drove the need to modernize artillery observation and reconnaissance systems, the introduction of precision weapons and operational environments. The first factor, the advent of precision guided weapons, increased the need for more sophisticated observation platforms, requiring real time data that had margins of error less than 30 meters. Second, the terrain Russia believes it will operate in is flat and open, the grasslands and plains of Ukraine and eastern Europe. The flat ground provides little in the way of highpoints to place observers with long fields of observation. Russia's modernization efforts with respect to observation equipment can be divided into three categories, radars, optical sensors, and UAVs.

Radars. The past decade has seen improvements and increased numbers of radar systems assigned to maneuver brigades. Russian radar systems at the brigade level fall into three categories, air defense radars, artillery locating radars, and ground sensing radars. The two air

defense battalions have numerous stand-alone and integrated radar systems, dedicated to detecting UAVs, rotary wing, and fixed wing aircraft. The fire control battery at the brigade level has six radar systems, two self-propelled artillery locating radars and four vehicle mounted ground sensing radars. The artillery locating radars are either the IL-219 (Zoopark 1) or IL-220 (Zoopark 2) radar systems.⁶⁴ These radars can accurately locate mortar, howitzer, and rocket fires at ranges up to 50 kilometers. These systems are also capable of locating adversary radar systems through passive electromagnetic spectrum monitoring. The Zoopark 1 is able to emplace and displace in 15 minutes, while the Zoopark 2 can emplace within 10 minutes.⁶⁵ The Russian army is upgrading its IL-219 systems to the IL-220 system, providing additional range, faster emplacement times, better electronic countermeasures, and more robust communications capabilities. The fire control battery also employs four SNAR-10 vehicle mounted ground sensor radars. These systems are primarily used to sense and identify moving vehicles out to 40 kilometers, though it has the ability to locate artillery impacts. The shell impact feature has been used to adjust artillery rounds that go unobserved by other systems.⁶⁶ Additionally, each maneuver company within mechanized and motorized brigades are equipped with the FARA-1 dismounted ground sensor radar. These systems provide another observation system able to observe out to 2.5 kilometers.⁶⁷ In combination, these radar systems provide the Russian maneuver brigade multiple and redundant systems to conduct observation through vehicle and munitions tracking as well as monitoring adversary radar emissions.

Visual systems. Forward observer teams have also seen an influx of modernized equipment since 2008. To improve its visual observation capabilities within frontline units, the Russian army developed and deployed the PRP-4A Argus Artillery Reconnaissance vehicle. The Argus includes an optical laser range finder capable of locating vehicles out to ten kilometers.

The system has an additional ground sensing radar for wide scanning observation and is fully digital, capable of transmitting target location data directly to the Command Observation Post. Additional improvements have been made to dismounted systems as well, including man portable systems capable of laser designating targets and accurately locating targets out to ten kilometers.⁶⁸ These systems provide additional observation capabilities for the Russian reconnaissance complex, enabling rapid observation and calls for fire along brigade and BTG front lines.

UAVs. UAV growth within the Russian army has grown exponentially over the past ten years. Since 2008 Russia has developed and deployed over 20 new tactical, micro, nano, and medium altitude long endurance (MALE) UAVs.⁶⁹ These UAVs are utilized for observation and EW attack and support. Russian brigades are assigned one UAV company with three UAV platoons, while micro UAVs are found within maneuver battalions, companies, and platoons. UAVs have been extensively incorporated into the artillery reconnaissance complex, and Russian forces have extensively utilized the Orlan-10 UAV for artillery spotting.⁷⁰ The Orlan-10 is a micro UAV weighing only 35 pounds with an operational range of 140 kilometers. Capable of day and night operations, infrared capabilities, and limited EW capabilities the Orlan-10 is able to locate targets within one meter of accuracy. The Orlan-10 utilizes both the US GPS constellation and the Glonass satellite constellation for target and self-location, making the Orlan-10 difficult to jam and cause a GPS fault. Russia continues to rapidly modernize its drone force, with over eleven new models of UAV introduced in 2019. Future modernization efforts for artillery reconnaissance UAVs include integrating targeting data directly into the Andromeda and Strelets command and control systems.⁷¹ These UAVs enable the Russian brigade or BTG commander to conduct wide ranging reconnaissance of the battlefield without higher

headquarters assets. Tying UAVs directly to artillery formations has led to extremely fast acquisition to engagement times with devastating results in both Ukraine and Syria. With the widespread success of UAV employment under combat conditions, the Russian army will only increase its UAV capabilities in the near future.

Electronic Warfare. As operations commenced in Georgia in 2008, the Russian air force lost five aircraft to Georgian air defense systems. Reviews of the engagements revealed that the downed aircraft lacked sufficient EW defense systems, both on the aircraft and within supporting ground forces, to effectively operate against modern air defense systems.⁷² In light of the reviews, the Russian Ministry of Defense made EW system modernization one of the highest priorities of the 2008 “New Look” reforms. The Russian army has developed EW systems that perform three types of actions, electronic support, electronic protection, and electronic attack. Electronic support provides intelligence capabilities for the Russian army, including radio frequency (RF) location and direction finding, electronic intelligence (ELINT), signals intelligence (SIGINT), communications intelligence (COMINT), and measures and signals intelligence (MASINT).⁷³ Electronic protection capabilities provide EW emissions control and EW camouflage as well as the electronic weapons interference. Russian EW protection systems have been utilized to detonate electronic artillery and missile fuzes prior to the weapon systems reaching their targets. EW attack systems include the ability to jam enemy (radio and satellite) communications, spoof GPS systems, sensor jamming and interference (radars, infrared sights), and provide guidance and targeting for weapon systems. These capabilities have been incorporated into dismounted, vehicle mounted, munition launched, and UAV systems.⁷⁴ While different EW systems located within Russian brigades have specific uses, all EW systems are capable of conducting RF direction finding. These systems are closely tied to the Command

Observation Posts of artillery units and have been used extensively for targeting within Ukraine and Syria.⁷⁵ These systems provide Russian forces excellent capabilities to disrupt and then target adversary EW and command and control systems, as well as suppressing fires formations.

Tactics

Fires Planning and Execution. The Russian army is an artillery army. The tradition of the Russian army as a fires based army extends back to World War II, where Soviet forces were described as a massive artillery formation with an excessive number of combat vehicles. The reliance and focus on artillery continued throughout the Cold War with the development of the Deep Battle concept, an operating concept based on tactical, operational, and strategic fires ranging and striking enemy formations in depth.⁷⁶ Russian formations and tactics continue to revolve around overwhelming fires to attrite and disrupt enemy formations prior to maneuver forces engaging.⁷⁷ Currently, Russian forces are evolving the doctrine of the Russian strike complex, where Russian artillery and fires systems are central to both offensive and defensive operations. The strike complex doctrine is finally maturing into an effective option due to the modernization of observation and communication systems. The Russian strike complex, known as RYS within the Russian forces, utilizes multiple and layered reconnaissance assets (visual, EW, radar, UAV) and new digital command and control architectures to rapidly locate and engage targets with kinetic and electronic fires.⁷⁸ These tactics have seen a great deal of improvement and maturation since the 2008 Georgian invasion and operations within Ukraine and Syria.

The primary objective of the RYS at the brigade and BTG is to overwhelm enemy formations with EW attacks to disrupt and prevent coordination followed by devastating massed artillery strikes and limited precision strikes on high priority targets. The RYS executes these

missions through dynamic and pre-planned targeting methods while attempting to achieve four categories of effects.⁷⁹ It is worth it to note that all non-precision Russian fire missions are targeted at wide areas, not specific targets. While an identified target may form the center of the area fires, individual munitions will rarely target the actual location of the artillery strike. Dynamic, or on-call, targets are engaged using two types of fire, the individual target and fire concentration. Individual targets are on call fire missions targeting low priority targets of opportunity. Russian tactical fire direction elements will usually only dedicate a small number of tubes to engage, typically a battery or platoon (three to six guns). Fire concentration works similarly, but on a much larger scale. Fire concentration strikes on targets of opportunity are executed with a battalion or, usually, multiple battalions utilizing a mixture of munitions for increased effect. Fire concentrations target larger formations and are often accompanied by EW attacks to disrupt early warnings and indicators and prevent medical evacuations and counter battery support.⁸⁰ An example of a fire concentration attack is the artillery strike on two Ukrainian mechanized battalions at Zelenopillya in 2014. After laagering for the night, the two battalions were observed by an Orlan-10 UAV. Within ten minutes the battalions' radio and GPS communications were jammed, and approximately 20 minutes after first observation received between one and three battalion sized strikes from Tornado MRL systems. These strikes mixed thermobaric and high explosives to devastating effect, in which the battalions suffered over 150 casualties and almost the complete loss of all armored vehicles in the two battalions.⁸¹

Pre-planned targets and artillery strikes form an important part of the Russian brigade and BTG's tactics. Pre-planned fires fall into four types, barrage fire, rolling barrages, massed fire, and successive concentration. Pre-planned fires are targeted against known and suspected enemy

defensive positions or against terrain that the brigade or BTG is attempting to seize or secure. On call targets are executed in order of priority, with enemy nuclear systems, artillery systems, FASCAM systems, command posts, and reconnaissance elements considered high payoff targets.⁸² Barrage fire is similar to the US concept of final protective fires. Barrage fires are primarily defensive, and are planned as a linear target 300-400 meters in front of friendly troops. Artillery units assigned a barrage fire will fire continuously until out of ammunition or requested to cease loading. Rolling barrages are similar, but used both offensively and defensively. Rolling barrages are a series of linear targets executed sequentially as maneuver forces advance or withdraw. Rolling barrages prevent enemy forces from accurately engaging or following Russian forces. The rolling barrage was employed during the engagements in and around Debaltseve, preventing Ukrainian forces from initially closing with and later retreating from Russian forces.⁸³ Massed fire is a set of area targets executed simultaneously by multiple battalions. These types of fire suppress wide areas and are used when exact locations of high priority targets are unknown. Russian forces besieging the Donetsk airport utilized massed fires to suppress widely dispersed and concealed Ukrainian defensive positions during attacks to seize the airport.⁸⁴ The final type of fires employed by the Russian strike complex are successive fire concentrations. Successive fire concentrations utilize a sequence of area targets along the axis of advance of maneuver forces. These targets are engaged and then shifted based on ammunition expenditure, time, or by request. Examples of successive fire concentration can be seen during the Ukrainian retreat from Debaltseve. Area targets were established along potential retreat routes and executed in sequence, killing over 250 Ukrainians and destroying dozens of armored vehicles.⁸⁵

The described fire mission types are designed to achieve four different effects (annihilation, destruction, neutralization, and harassment), based on amount of enemy personnel, equipment, and capabilities the fires degrade. Annihilation fires are executed by multiple battalions and aim to attrite an enemy until they are unable to be reconstituted in any form. Destruction fires reduce a unit to combat ineffectiveness, capable of only sporadic resistance. Neutralization fires aim to temporarily deprive a unit of combat effectiveness, either through disruption, suppression, or destruction of key systems. Destruction and neutralization fires are executed by battalion sized elements. The final effect, harassment fires, are used to disrupt enemy formations, tempo, and communications. Harassment fires are also used to conduct reconnaissance by fire, attempting to make an adversary reveal positions and systems through a response. Harassment fires are executed by single batteries utilizing temporary firing positions.⁸⁶ Examples of harassing fires are found in operations within the Donbas, where Russian artillery batteries would fire small harassing missions towards Ukrainian lines. The Ukrainian counterfire would be immediately suppressed by additional battalions on standby to engage any response. These harassment fires resulted in the Russian forces attriting Ukrainian artillery units by over 60% during operations in 2014 and 2015.⁸⁷

Artillery Positioning. While fighting as a brigade or a BTG, artillery positioning tactics remain consistent. Due to a lack of fire direction centers for each platoon, communications range limits, and preference for massed fires, Russian forces will often form artillery ‘parks.’ These parks are similar to the US concept of Position Areas for Artillery, but are occupied by multiple battalion sized elements. Within the artillery park howitzer batteries will occupy one primary position and have one to two alternate positions established. Batteries will displace and move to their alternate and subsequent positions after a certain number of rounds have been

expended. Howitzer artillery parks are generally located five to six kilometers behind the forward line of troops (FLOT), although Russian artillery positions in Ukraine have been observed as close as 500 meters from the front line.⁸⁸ The aggressive positioning during operations in Ukraine enabled howitzer crews to execute direct fire missions on Ukrainian armored vehicles. Russian artillery forces will also designate a ‘roving’ battery for harassment fires. This battery will leave the artillery park and rotate through several firing positions to execute harassment fires before returning to the park. MLR systems and battalions are often located farther towards the rear, occupying firing positions eight to ten kilometers from the FLOT. Similar to howitzers, MRL units will have a primary and one to two alternate positions. Russian artillery forces prefer to keep their howitzer and launcher sections relatively close together, with only 30-50 meter spacing between systems. This helps facilitate command and control as well as mitigate logistics and communications issues.⁸⁹ Radars and observers are placed with maneuver units, operating along the FLOT. The Russian tactics for positioning artillery provide advantages for massing fires, but leave units vulnerable to detection and counterfire.

Observation Tactics. Russian forces are evolving observation techniques as new equipment rolls out to the force, but trends from Syria and Ukraine are emerging. Russian forces are dramatically increasing the use of EW systems, UAVs, and radars for observation, target location, and adjustments of artillery strikes. These systems can be used as stand-alone observers, but are more commonly used in synchronization.⁹⁰ A common technique is to obtain a general location of enemy forces through EW direction finding equipment and send a single or group of UAVs to confirm the target location and send targeting data to firing units. Once target locations are confirmed, EW assets will jam communications and artillery fires will commence.

The Ukrainian's report that the average response time from being detected to receiving fire is ten minutes.⁹¹ UAVs have also been observed adjusting artillery rounds to ensure accuracy. UAVs have also been seen operating in groups of three to four, often utilizing different systems on each UAV. One to two UAVs will be equipped for visual observation, one for EW detection and jamming, and one for communications relay.⁹² Russian forces continue to develop and improve their UAV observation tactics, techniques, and procedures through real life application on the battlefields of Ukraine and Syria.

Russian Fires Complex Vulnerabilities

Despite the rapid modernization, improvement in equipment, and reorganization of forces, the Russian brigade, BTG, and supporting artillery forces have multiple vulnerabilities that US forces can exploit. These vulnerabilities stem from both tactics and equipment design, and include centralization of assets and forces, reliance on UAVs and EW assets for surveillance, and issues with logistics.

Current Russian tactics with regard to brigade and BTG artillery support often collocate and centralize assets.⁹³ The centralization of assets occurs within command and control elements, technical fire direction elements, and firing units. With much smaller staff elements than US counterparts, Russian command and control elements at both the brigade and BTG level are often collocated. These elements do not have the personnel or systems to split into multiple command elements such as a main command post and tactical command post. Russian forces also often collocate artillery command posts with maneuver command posts. This speeds fires in support of maneuver forces, but poses risks if located and targeted. The lack of secondary command posts poses an issue when communications are disrupted or the command element is destroyed. Efforts focusing on disrupting and destroying command elements by targeting

Command Observation Posts will help desynchronize artillery support and coordination of the brigade and BTG. Russian technical fire direction assets are also highly centralized, as each battalion and battery only include one Fire Direction Center (FDC). The battery FDCs are limited to executing battery fire missions, and do not directly communicate with observers. Targeting FDCs will produce disproportionate disruption, as eliminating the artillery battalion FDC cuts the communication link with observers and batteries. Targeting battery FDCs will prevent guns from operating, as each battery does not have a backup FDC and cannot execute technical fire direction of battalion sized elements. In addition to centralizing command and control and fire direction assets, Russian forces also collocate their artillery systems. Battalions and batteries are collocated in ‘artillery parks’, with spacing between guns often not exceeding 40 meters.⁹⁴ Guns are collocated to ease logistics issues and to prevent communications problems. Communications gear within the launchers and howitzers are extremely limited on range and reducing distance between systems reduces issues. While Russian forces do establish alternate and subsequent positions within their established artillery parks, they often re-use the same firing positions. These collocated units, preference for limited dispersion, and the repeated use of positions provides an opportunity for US forces to locate and target Russian artillery systems. Artillery parks have large visual and EW signatures, and the lack of dispersion makes them vulnerable to counterbattery fires.

Russian forces operating in Syria and Ukraine have begun to develop a reliance on UAV and EW observation assets for target location.⁹⁵ While these systems have proven extremely effective, they are also prone to disruption. UAVs are easily tracked and observed through several methods, Ukrainian forces report that the Orlan-10 system, most often used in artillery observation, flies at very low altitudes and is easy to spot on the ground.⁹⁶ The systems are also

easily tracked by radar. The UAVs can be disrupted by shooting them down (either with air defense assets or with ground fire) or jammed by EW assets. Once the UAV systems have been disrupted, Russian forces often struggle to accurately locate enemy forces.⁹⁷ Additional means of disrupting UAV reconnaissance include rapid displacement and camouflage. Fire mission times average ten to fifteen minutes after a UAV has located a target, and Ukrainian forces have found displacing within that timeframe prevents effective artillery strikes.⁹⁸ Returning to traditional military skills such as camouflaging positions has also seen effectiveness in disrupting UAV observation techniques.

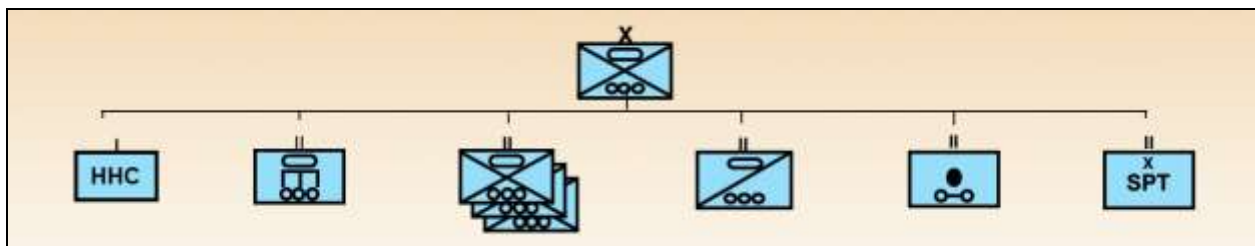
The last major vulnerability of the Russian brigade and BTG centers on logistics, especially the replenishment, resupply, and maintenance of front-line units. While Russia plans to field over 125 BTGs by 2021, most maneuver brigades are only operating at 50% manning levels.⁹⁹ While priority fill is place on BTGs, brigades and army groups have few replacement troops and formations to fill front line losses. This extends to equipment as well, though Russian modernization efforts have greatly improved the quality of Russian arms, there are not enough systems to equip all units with modern equipment. For example, Jane's estimates that Russia has only produced 1100 2S19M2 howitzers, enough to only equip 112 of the proposed 125 BTGs.¹⁰⁰ BTGs not equipped with the latest equipment will have degraded ranges and capabilities. The more losses suffered by front line and reserve units, the more frequently less capable equipment will be deployed, including short-ranged towed howitzers as artillery support. Russian forces also suffer from resupply issues during extended campaigns. Centralized supply systems that suffer from inefficiencies and disorganization have prevented essential munitions and parts from reaching front line units. While Russia has made significant strides in improving its strategic and operational logistics systems, significant issues remain at the tactical level.¹⁰¹ Disrupting and

targeting logistics elements would exacerbate issues with an already fragile system. Finally, Russian systems lack the capability to conduct extensive field maintenance. With the growing complexity of systems in conjunction with a less than robust logistics system creates issues keeping equipment fully operational. With these logistics issues, Russian forces will seek short, intense operations to seize objectives and inflict casualties to mitigate replenishment and resupply issues associated with long-term conflicts.

Current US SBCT Organization

The current US Army unit on the ‘front lines’ of eastern Europe is the 2nd Armored Cavalry Regiment, a Stryker Brigade Combat Team (SBCT). The SBCT is organized similarly to both infantry and armored brigade combat teams, and units are equipped with variants of the M1126 Stryker Infantry Carrier Vehicle. The SBCT contains three infantry battalions, one reconnaissance squadron, one artillery battalion, one support battalion, and one engineer battalion (See Figure 6). The engineer battalion is composed of only one engineer company but includes a signal and military intelligence company. The SBCT contains approximately 4000 Soldiers and is capable of independently sustained operations for five days.¹⁰² With higher echelon logistics support, the SBCT can function independently on the battlefield, executing missions without requiring task organized support.

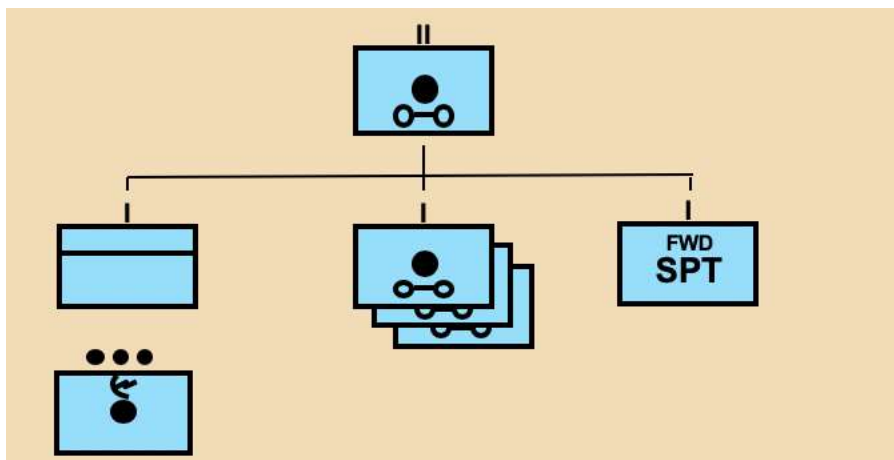
Figure 6¹⁰³:



The Field Artillery battalion within the SBCT contains three firing batteries, one headquarters battery, and a forward support company (see Figure 7). These batteries provide the

SBCT with 18 M777A2 towed howitzers, one radar platoon with five radar systems, and enough ammunition carrying capacity to support combat operations for two days. Howitzer batteries are organized into two platoons of three howitzers and one FDC, providing the capability to execute split platoon and widely dispersed operations.¹⁰⁴ The M777A2 is capable of ranging 19 kilometers with conventional munitions such as high explosives, smoke, incendiary, and FASCAM rounds. Utilizing Rocket Assisted Projectiles, the M777A2 can range up to 30 kilometers. Precision guided munitions, such as the M982 Excalibur round, can range up to 40 kilometers.¹⁰⁵ The forward support company contains a transportation platoon for resupply and a maintenance platoon for field repairs. The headquarters element provides battalion staff support, a radar platoon, and a medical platoon. The radar platoon is equipped with one ANTPQ-36 and one ANTPQ-37 trailer mounted fire-finder radars for counterbattery operations, though these systems are being upgraded to the ANTPQ-53 vehicle mounted systems. Additionally, the radar platoon operates three ANTPQ-50 vehicle mounted fire finder radars. The SBCT's towed artillery battalion is capable of providing a variety of direct support fires for the maneuver commander.

Figure 7¹⁰⁶:



The US Army has recently re-introduced the Division Artillery (DIVARTY) formation. With the return to the Division as the primary tactical fighting formation during Large Scale Ground Combat Operations (LSGCO), the US Army re-established the DIVARTY as the Force Field Artillery Headquarters (FFAHQ) for the division.¹⁰⁷ These organizations have been established as the fire support element for the division, but do not have any assigned fires assets, and only consist of staff elements.

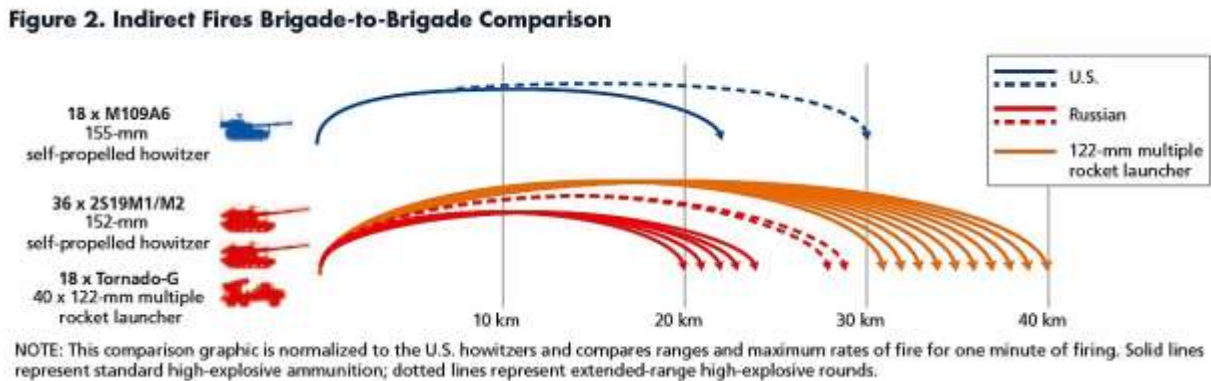
Comparing Russian and US Tactical Fire Support Systems

The Russian brigade and BTG has some significant advantages over the US SBCT in terms of artillery and fire support assets. Russian forces hold an advantage in range, number of launcher systems, and observation systems. Adding Russia’s EW capability advantages at the tactical level increases the disparity between Russian and US capabilities. The Russian brigade contains 36 howitzers and 18 MRL systems four long range radars, compared to the SBCT’s 18 howitzers and two long range radars. Even compared to the BTG, which has 12 howitzers and 6 MRL systems, the US SBCT finds itself outgunned (see Figure 8) and outranged (see figure 9).

Figure 8¹⁰⁸:

Fires Asset	Russian BTG	Russian Brigade	US SBCT
Howitzers	12	36	18
MRL Systems	6	12	0
Mortars (81mm or larger)	16	48	40
Long Range Radars (range of 10+ KM)	0	4	2

Figure 9¹⁰⁹:



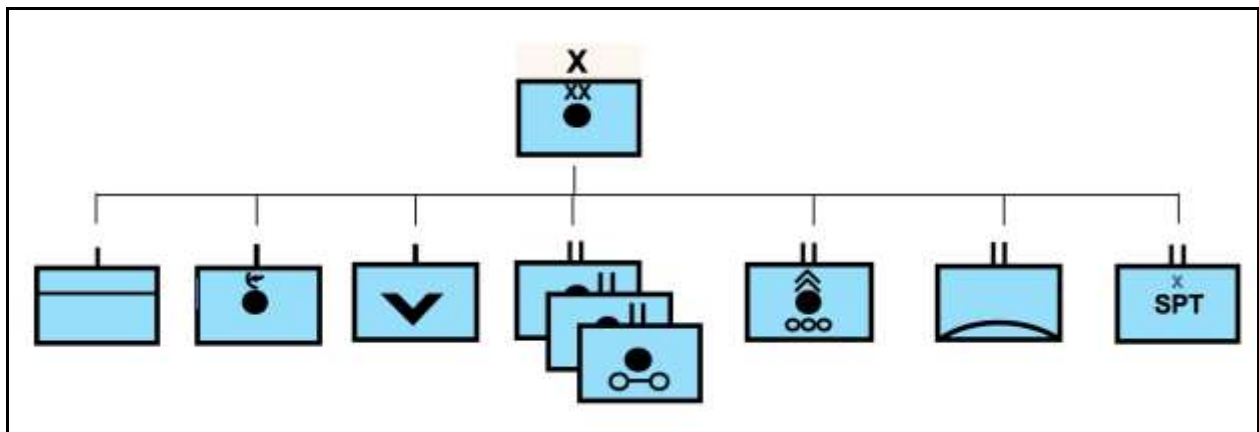
An additional problem facing US artillery formations is the organization of US fires systems. Currently, US artillery formations have no organic long-range reconnaissance platforms. While SBCTs do contain a UAV platoon, the four UAVs are shared across all four maneuver battalions as well as the brigade's S2 cell. These assets are primarily tasked to maneuver units and objectives. Russian formations regularly supply artillery formations with UAVs dedicated to hunting down and locating enemy fires assets. The ability to conduct long-range reconnaissance specifically for artillery targets provides the Russian fires complex additional advantages during operations.

Reorganizing US Artillery Formations

In order to effectively combat Russian forces, the US Army should focus on reorganizing and restructuring the DIVARTY elements within each Division. Based on current force projections and structure, the US Army will not outnumber Russian artillery pieces on the battlefield. While manning an equal number of artillery battalions is too cost prohibitive, but the US Army can defeat Russian formations through reorganization. Using the DIVARTY, a centralized artillery formation within the division, division commanders can either weight artillery assets towards the decisive effort or spread the fires assets evenly throughout the

division. Centralizing artillery within the DIVARTY provides a more flexible option for employing artillery than the current direct support battalion concept. The DIVARTY will also have an expanded set of capabilities, including MRLS units, dedicated UAV assets, dedicated logistics, and a more robust radar package. The redesigned DIVARTY will have three howitzer battalions, one MRL battalion, one air defense battalion, one support battalion, a target acquisition battery, a UAV company, and a headquarters element (see Figure 10).

Figure 10:



This proposed structure would support a division with three subordinate brigades, able to provide the commander with a wide range of flexible options for artillery employment. With the ability to mass large numbers of howitzers and an MRL capability for long range and precision fires capabilities, the division can accomplish any fires task required without requesting additional assets.

The DIVARTY Headquarters and Headquarters Battery (HHB) would remain unchanged from current DIVARTY structures. The DIVARTY HHB would continue to house the DIVARTY staff elements, division Fire Support Element (FSE), medical platoon, and signal platoon. The medical and signal support platoons would be more robust than medical and signal

support elements found within the battalions, enabling the DIVARTY to train and support subordinate platoons.

The Target Acquisition Battery (TAB) would be re-formed within the DIVARTY. Consisting of a headquarters element and three radar platoons, the DIVARTY will be able to train and manage the radars across the battlefield. Each platoon would consist of seven radars, three ANTPQ-53 fire finder radars and four ANTPQ-50 radars, representing an increase in three ANTPQ-53 radars across the division. Platoons could be employed by assigning them direct support roles with a habitually related howitzer battalion or operate under centralized control across the division area of operations. The additional radars, whether employed in a decentralized or centralized manner, provides the unit much greater with operational flexibility and survivability than the current two radar structure. With three vehicle mounted radars, one system can be operational and scanning for counterfire operations, one system emplacing or resupplying, and one system moving to a subsequent position. This three-system 'leap-frog' technique provides better coverage of the battlefield, reducing the amount of time the unit is not under the protection of radar surveillance. Under the two-system construct, brigades are often left without radar coverage while systems are moving or down for maintenance. Utilizing three systems also allows for shorter queuing from any single radar, reducing the radar's exposure to enemy EW detection assets. Reintroducing an enhanced TAB to the DIVARTY provides increased flexibility and reliability of counterfire radar coverage for the division, enabling effective location and targeting of Russian fires assets.

The revised DIVARTY would include a UAV company structured to provide long range observation, signals intelligence, and communications relay capabilities. The UAV company would contain a headquarters element and two UAV platoons. The two UAV platoons will be

equipped with two variants of a trailer launched UAV, one equipped for EW detection and visual observation and the other equipped for radio retransmission. These UAVs should have operational ranges of over 100km and loiter times exceeding nine hours. The range and loiter times allow for the UAVs to continuously scan for targets at the maximum range of the artillery systems or provide uninterrupted communications relay support. The US Army's current RQ-7A Shadow meets these requirements, and with the Army currently searching for a replacement, adequate numbers of the RQ-7A may be available to field within DIVARTYs.¹¹⁰ The UAVs would be directly assigned missions and tasks by the division FSE and DIVARTY Commander, providing targeting information and communications relay without re-tasking UAVs from supporting maneuver forces. These UAVs would fill the aerial observer role that Cessna O-1 Bird Dog pilots filled during World War II, the Korean War, and the Vietnam War. After Action Reviews from those conflicts highlighted the importance of aerial observers and a robust UAV capability tied directly to the artillery formation would return those benefits to the division.¹¹¹

The restructured howitzer battalions would remain relatively unchanged, with three firing batteries, a headquarters battery, and a forward support company. Changes would be made to the platoon structure and the equipment utilized by the battalion. The current configuration and equipment of the direct support Field Artillery battalions supporting SBCTs have several issues, including the lack of resupply vehicles, too few guns per platoon, and the towed howitzers themselves. The reorganized howitzer battalions would add an ammunition platoon to each battery, increase the number of howitzers per platoon from three to four, and replace the M777A2 towed howitzer with a self-propelled system.

During the US Army's transition to the Brigade Combat Team (BCT) in the early 2000s a majority of ground transportation assets were divested from unit force structure.¹¹² Numbers of

transportation trucks (primarily the Heavy Expanded Mobility Tactical Truck (HEMTT) and Family of Medium Tactical Vehicle (FMTV) systems) were cut by roughly half, leaving BCTs with inadequate transportation assets. Sustainment battalions organic to BCTs have struggled to supply multiple infantry and artillery battalions during large scale exercises at the National and Joint Readiness Training Centers. Each Field Artillery battalion currently has a Forward Support Company (FSC) with a transportation platoon, but this platoon is also inadequate to supply the three subordinate firing batteries. The FSC's transportation platoon is responsible for supplying the firing batteries and headquarters elements with all classes of supply, and suffers from the same issues the brigade's support battalion does during simulated combat exercises. Currently, each artillery platoon has three FMTV ammunition trucks, for a total of six per battery. These trucks are capable of carrying a maximum of 650 complete rounds (fuze, projectile, and propellant). Based on average expenditure rates during Combined Training Center (CTC) rotations, 650 rounds are usually expended within 24 hours of combat operations.¹¹³ Heavy firing cycles consisting of obscuration missions, counterfire operations, and FASCAM emplacements will deplete a battery's ammunition stockpile significantly faster. While howitzer batteries have ammunition trucks that are separate from the prime movers, these vehicles are crewed by the howitzer sections. A battery cannot send these ammunition trucks to a resupply point without sending howitzer crewmen, either degrading the crew's capabilities or preventing the gun from firing when reduced below seven crewmembers.

The addition of an ammunition platoon to each battery would greatly improve operational capabilities. A small platoon of 16 Soldiers operating four FMTVs with trailers and two HMMVWs would enable a battery to send the ammunition platoon to ammunition holding areas without interrupting firing operations. In addition to enabling battery firing operations, an

ammunition platoon would provide tactical flexibility. An ammunition platoon loaded with special munitions (smoke or FASCAM) would be able to establish hasty ammunition points for howitzers to fall in on and execute smokescreen or minelaying missions. The ammunition platoon will also reduce the stress on the FSC. Working in conjunction with the FSC, an ammunition platoon can effectively halve the distance transportation assets travel from higher unit supply areas to the firing elements. The addition of an ammunition platoon to each firing battery would greatly increase tactical flexibility and improve sustainment operations.

Changes to artillery force structure over the last fifteen years has seen artillery platoons reduced in size to three guns from four. Three-gun howitzer platoons have decreased combat effectiveness and are unable to effectively execute many basic fire missions. While executing fire for effect missions smaller platoons cause significantly less casualties. The addition of a single gun can dramatically increase the effects of fire missions, providing maneuver commanders better support. These smaller platoons are also unable to effectively execute basic fire missions independently. For example, building a 200-meter-long smoke screen with three guns takes over 25 more rounds, and with fewer guns firing, approximately eight more volleys than a four-gun platoon.¹¹⁴ This leaves the platoon in position for up to five minutes longer and dangerously exposed to counterfire. Range-spread illumination missions are also impossible to execute with a three-gun platoon. Increasing the number of howitzers per platoon to four would greatly increase the effectiveness and tactical flexibility of artillery units.

Modern advancements in acquisition technology and assets make the battlefield increasingly lethal and has dramatically increased the pace of warfare. The increased battlefield awareness of enemy forces and speed at which targets can be engaged have made speed and mobility a critical factor in survivability. The M777A2 towed howitzer is too slow and

cumbersome to survive on today's battlefield and needs to be replaced with a self-propelled howitzer. Russian forces are able to effectively execute fire missions on targets within five minutes of accurately locating a target.¹¹⁵ This poses a significant problem for M777A2 units, which requires approximately nine minutes to displace and begin moving to a new location. While nine minutes is the standard, the average M777A2 battery displaces in 14 minutes under continually operations during training rotations at the National Training Center.¹¹⁶ Towed howitzer platoons will not survive during combat operations. Highlighting this lack of survivability is the 80% casualty and equipment loss rate of Ukrainian towed artillery systems. Utilizing the D30, which is faster to displace and move than the M777A2, Ukrainian artillery forces have been devastated during operations in the Donbass and Donetsk. Contrasting the high casualty rates of the towed artillery systems, Ukrainians have suffered only 15% casualties among front line self-propelled howitzer formations.¹¹⁷ The US Army's current self-propelled howitzer, the M109A7 Paladin, can emplace and displace within 45 seconds, drastically improving its survivability. The US Army must upgrade field artillery units within SBCT formations with self-propelled howitzers to increase survivability on today's battlefield.

The DIVARTY will be task organized with an MRLS battalion, providing organic long range and precision fires to the division. SBCT supported divisions will be equipped with the M142 HIMARS MRL system, providing US Army standard MRL capabilities including guided and unguided rockets as well as the Army Tactical Missile System (ATACMS). The immediate benefit of adding a HIMARS or MRLS battalion to the DIVARTY is the drastic increase in range, extending ranges to 70 kilometers with rockets and 300 kilometers with ATACMS. Additional rocket munitions are in development to extend the HIMARS range to 499 kilometers.¹¹⁸ The 70-kilometer range on the HIMARS provides the division commander with

an asset that can match the range of the latest Russian MRL systems currently supporting brigades and BTGs. The HIMARS can act as a dedicated counter battery force as well as a precision strike asset for high value targets. The increased range, destructive power, speed, and accuracy of HIMARS munitions makes the platform ideal for ranging deep into enemy formations to disrupt key systems. Functioning as a pseudo- General Support artillery unit within the division, the HIMARS battalion can position itself to support wide frontages during division maneuvers, enabling the cannon systems to be centralized to support the main effort. The battalion provides the tactical flexibility without support from outside units. Currently, the US Army task organizes a battery of HIMARS to deployed units and brigades training at Combat Training Centers (CTC). HIMARS batteries have been attached to BCTs in 16 of the last 18 CTC rotations, providing support for training brigades. The HIMARS units often become the main source of artillery support for the brigade due to their ability to range targets without lengthy repositioning and their ability to engage from beyond counter battery ranges.¹¹⁹ While task organizing HIMARS batteries to brigades during training is an adequate solution, during a large-scale conflict in Europe or other theater the limited number of HIMARS currently in the US Army may prevent support to the BCTs and divisions. If HIMARS are task organized to BCTs, the Corps and division will lose its General Support and Reinforcing artillery formations. The US Army has already recognized the need for additional HIMARS and MRLS battalions, creating four new battalions over the next two years. These formations should be built into the new DIVARTY, establishing training, support, and operational familiarity within a supported division.

Almost all short-range air defense assets were removed from the active duty US Army over the past 15 years, leaving maneuver and artillery forces exposed to aerial threats. With the

increasing threat of drone observation and strikes along with the possibility of facing adversaries with helicopter and fixed wing assets, the reorganized DIVARTY should include a Short-Ranged Air Defense (SHORAD) battalion. Comprised of three batteries, the SHORAD battalion would be able to provide the division and supported SBCTs with air defense systems protecting against medium range missiles, UAVs, helicopters, and close air support fixed wing aircraft. Retaining a battalion of air defense at the division level provides the division with the flexibility to protect key assets as opposed to spreading the air defense systems thinly across the battlefield. The SHORAD battalion should be equipped with two types of systems, a mobile system designed to keep pace with front line units and point defense system for defending logistics areas and command posts. The US Army is currently designing two systems for these purposes, the Maneuver-SHORAD (M-SHORAD) vehicle and a trailer mounted multi-mission launcher. An M-SHORAD system based on a Stryker vehicle utilizing Stinger missiles will enter service in 2020.¹²⁰ Additional M-SHORAD systems utilizing guns and lasers to inexpensively down cheap micro UAVs are also in development. To guard fixed logistics sites and command posts, the US Army is purchasing the Israeli Iron Dome system, until a domestic system is developed. All these systems will be assigned to independent Air Defense battalions.¹²¹ Not organizing these systems and units into maneuver forces will slow deployments, training, and familiarity of employment. The most effective organization of these SHORAD assets is within the division and assigned to the DIVARTY.

Conclusion

In their current configurations, Russian ground forces hold considerable advantages over US ground forces at the division and brigade levels. The number and type of weapon systems, EW assets, and target location systems provide the Russia forces the ability to outrange, outgun,

and fire more responsively than American forces. The Russian's have not achieved this overmatch through new or exotic technology, but through a focused modernization effort to upgrade systems and to reorganize those assets into a more efficient structure. Other adversaries have watched Russia's operations in Syria and eastern Ukraine intently, learning and upgrading their own fires complexes. The US can degrade and match Russia's current advantages by reequipping and reorganizing its own artillery forces. Reintroducing the DIVARTY structure, providing additional assets, and equipping the formation with new launchers and acquisition assets will provide US ground forces at the division and brigade level with organic systems capable of overmatching current adversary threats.

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