Russian Tactical Correlation of Forces & Means Computation Updated for Modern Equipment and Capabilities

by Lester W. Grau, Ph.D., and Mr. Clint Reach

***Editor's Note: This article is part two of a two-part series on the Soviet correlation of forces and means. Part one, titled "A Mathematical Probability of Success for Soviets in Cold War Confrontation," was published in the April–June 2021 issue of the* Military Intelligence Professional Bulletin.**

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Introduction

Russians have long pursued mathematizing battle, believing that the inherent values of various weapons and systems can be measured and compared against a single quantitative standard. The military professional may suspect the existence of such a relationship, but proving it has been difficult. The Soviet military sought to reduce tactical and technical aspects of military science to measurable, objective indices from which decisions could be made or otherwise substantiated. A sub-element of Soviet military operations research was the correlation of forces and means (COFM) methodology. COFM is still considered a powerful tool for helping operational- and tactical-level commanders in their decision-making processes. The Russian definition of COFM is basically unchanged from the Soviet definition:

> ***The Correlation of Forces and Means [Соотношение сил и средств] is determined by comparing the quantitative and qualitative characteristics of subunits, units, formations, weapons, military equipment, etc., of one's own forces with those of the enemy. This provides an objective indicator of the combat power and the operational/tactical potentials of the opposing sides and allows one side the opportunity to take measures to gain superiority over the other side. The correlation of forces and means (COFM) exerts great influence (sometimes the deciding influence) on operational and tactical plans during their preparation and refinement with the aim of the timely determination and support for the necessary superiority over the enemy on the selected axes.[1]***

As with all operations research-related techniques, COFM's focus is toward the ultimate "goal" of a particular task—specifically, the direct numerical comparison of forces. Its principal mechanisms are (1) the quantification of selected battlefield elements, and (2) the mathematical expressions (or formulae) that relate those elements in such a manner to support decision making. These mechanisms are used to develop conclusions about the status of opposing combatants at particular stages of the unfolding battle.[2]

Statue of the Russian double-headed eagle that is part of the Russian Federation's coat of arms. Saint Petersburg, Russia[3]

COFM Enters the 21st Century

The Soviet Union collapsed and a smaller, weaker Russia emerged. Still, the COFM methodology survived.[4] Over time, the coefficients of commensurability were upgraded. Apparently, the upgraded system resembles the old system, only further computerized at the tactical level. The coefficients of commensurability (measurements of relative combat power) are derived using the standard methods of qualimetry, developed for quantitative measurement of the level of quality of industrial products.[5] A subset of the Russian discipline of qualimetry is military potentialometry, which focuses on military applications. The combat potential or quality of an asset or formation represents the asset's value and reliability under general conditions.[6]

Some Russian scientific research institute analysts and academicians are examining ways to improve the system. To their way of thinking, the coefficients of commensurability (or combat power) for individual systems is a good start; however, the effectiveness of the overall system is not equal to the sum of the effectiveness of its elements. Not all systems can be brought to bear at once, and the value of various systems varies with the type of combat conducted. These analysts believe it is unacceptable to put an equal sign between two complex systems—between a weapon or piece of military equipment and a military formation, regardless of the level of hierarchy—and apply the same methods of assessment to them. The effectiveness of the system is not equal to the sum of the effectiveness of its elements.[7]

The Russians' new approach to COFM would assess the abilities of subunits and below to perform their missions in various types of combat. In the offensive, they would assess weapon sets when the armed forces break through prepared defenses, when attacking a hastily occupied defense, and in a counterattack; in the defense, they would assess the conduct of military actions in prepared positions, in a hasty defense, and when repelling the enemy's offensive by deploying to a prepared line.[8]

During combat, the quality of various weapons of various types varies during the different stages. During the fires preparation for the attack, the combat capabilities of missile and artillery units, as well as aircraft flying along a determined axis, are most apparent. At the beginning of the attack, in addition to the quality of the artillery assets, the combat capabilities of the attacking motorized rifle and tank subunits are of greatest significance. When repelling an enemy counterattack, the quality of antitank weapons, close-combat weapons, and small arms is significantly increased. Therefore, a step-by-step assessment of weapon sets makes it possible to consider interrelated combat situations. The assessment thereby creates conditions for a solid forecast of the course of combat taking into account the influence of the weapons of each type on performing combat missions, and taking into account the counteractions of the enemy during each intermediate task.[9]

A proposed change to the current COFM is to use a BMP-3–based motorized rifle battalion tactical group (three motorized rifle companies and a tank company) as the standard or reference potential (base one) of the combined arms subunits of Russian troops. The combat potentials of other combined arms units should be determined in units of reference potentials.[10] Expected casualties could be calculated to adjust the combat potential of the friendly and enemy units during each stage of the action. Currently, this is just a proposal, and the current tactical battle planning is calculated using mathematics based on those shown in Annex A.

There are some problems with this approach. First, an 85 percent equipment readiness rate is often common at the operational level, but it is spread over a large formation. An 85 percent equipment readiness rate at the tactical level is usually not evenly spread over the battalion or brigade. Smaller units tend to have things go badly wrong simultaneously in the same category of equipment. Second, a battalion tactical group very often includes an accompanying howitzer battalion. The responsiveness and effectiveness of direct support/attached artillery are much different from supporting artillery and would skew those COFM calculations using a BMP-3–based motorized rifle battalion tactical group. Assigning a 20 to 25 percent equipment and personnel loss per tactical event (as suggested in the study) does not take into consideration that the bulk of losses in tactical combat is in the maneuver elements, not the combat support elements. Using a standard unit as base one is easier when doing calculations, but basing COFM calculations on operable systems still seems the best approach for now.

A More Contemporary Example of COFM (Tactical Level)

Not all tanks are equal. How can one determine the winner in a tank-versus-tank fight or in an antitank-guided-missile-versus-a-tank fight? Modern combat is seldom an isolated duel between individual systems. Modern combat is fought between units and subunits wielding a variety of weapons for which aggregate combat power is a determining factor in the battle's outcome. Rough COFM equations are still used to verify tactical decisions by determining combat outcomes. In 2011, the Department of Tactics and General Military Training of the Belarus National Technical University published a low-level tactical text titled "Combat Capabilities of the Motorized Rifle (Tank) Platoon, Subunits (Tank), and Their Calculation." Belarus is an ally of Russia and uses Russian equipment and military theory. This text was designed for military cadets in university-level

training.[11] Annex A is a translated extract of the text. The following summarizes the main points:

Mathematics supports the tactical commander's development of a course of action by answering the following questions:

- How many and what kind of forces will be necessary to accomplish my mission?
- What tasks can be accomplished with the forces and resources at hand?
- What result can be expected from the composition of all sides involved in the confrontation?
- How do I best use my forces and resources in order to achieve my objectives with minimal losses?[12]

These questions are addressed by calculations of combat capabilities of small units by a comparison of the combat potential of resources involved in the fight. Combat capabilities are quantitative and qualitative indicators that characterize the capabilities of military tactical units (platoon, company, battalion, and brigade).

Combat capabilities depend on—

- Number of personnel and level of their readiness for combat.
- Availability, condition, and quality of weapons and combat and other equipment.
- Ability of the commander and staff to lead the combat units.
- Organizational structure of forces and their logistical support.
- Composition and characteristics of enemy opposition, condition of the surroundings.
- Meteorological conditions, weather, time of year, and day during which combat occurs.

Particular indicators are realized in the combat capabilities of combat units of different types of troops:

- The width of the front lines (size of the stronghold).
- Depth of combat objective of the combat unit.
- Speed of movement of the combat unit.
- Depth of direct fires; effects on enemy targets.
- Effective radius of offensive weapons.
- Time required for subdivision to prepare (direct fires resources) to open fire.

The summed combat capabilities are—

- Fires capabilities—the total volume of fires tasks that can be accomplished.
- Strike capabilities—the capability of combat units to destroy the enemy through the combination of fires and maneuver.
- Maneuverability capabilities—the level of mobility and ability to move quickly.[13]

Russian scientific research institutes calculated the data to produce standard reference weapons. During the Cold War, the base standard reference weapon was the Soviet T-55 tank and was base one. Other ground forces equipment was rated against this weapon and assigned standard values. A similar process was used for air-to-air, air-to-ground, and naval combat.[14]

With the advances in technology, survivability, and firepower, there is a new set of standard reference weapons with base one as the T-72A tank.

How these values are used is demonstrated in the set of extracted student problems reproduced in Annex A. The future platoon leader would not necessarily have the time to do all of the math every time he put his platoon in position. The purpose of the training is to make the student comfortable and proficient with the system. The mathematics would be done regularly at battalion and brigade.

Modernizing for Today

Combat systems, sensors, communications, computers, targeting procedures, and onboard defensive systems have all evolved dramatically since the collapse of the Soviet Union. The COFM system was designed to provide predictability in military engagements. Today's world is more complex than during the Cold War, but the need for predictability still exists for tactical, operational, and strategic engagement—as well as nuclear use. Many of the aspects of the Soviet COFM system may appear clunky and outdated, but indications are that the Russians are attempting to provide military predictability using the computational power of modern computers.

It is clear that operational-tactical calculations are key during the commander's decision making when determining force composition and mission accomplishment.[15] In 2002, Major General Vorobyev, who once served in the Science Division of the Soviet General Staff, wrote—

> ***The use of computers plays a decisive role in performing operational-tactical calculations to coordinate interaction and model combat. They assist in rapidly determining the combat potential of units and subunits; their quantity and quality; the correlation of forces and means on a given axis; the COFM on subsequent missions; the effect of nuclear and conventional fire strikes on the enemy; the optimum composition of fire systems; the optimum methods for employing artillery, air defense and army aviation; the capabilities of reconnaissance and electronic warfare, and the organization of engineer supply and maintenance support.[16]***

An automated command and control system is a key development to allow Russia to obtain information dominance on the modern battlefield. It allows the Russian commander to quickly gain situational understanding, draft and transmit plans, and effectively execute combat more quickly than his adversary. The Russians believe that in high-intensity maneuver warfare, it is better to execute a satisfactory plan early than a custom-designed plan late.[17] The wide-scale computerization effort within the Russian Armed Forces supports their effort to continue to improve their COFM approach to modern combat and operations. Some of this is still murky, and there is a dearth of complete contemporary models; however, a look at Russia's COFM antecedents provides some clues. What's past is prologue.[18]

Standard Reference Weapons of Foreign Militaries

TYPE OF ARMOR & COMBAT EQUIPMENT	POTENTIAL
BMP, BTR, TANKS	
M1 "Abrams"	1.47
M1 A1 "Abrams"	1.87
M60 A2	2.60
"Leopard" 1A4	0.88
"Leopard" 2	1.90
"Leopard" 3	2.80
"Chieftain" MK-5	0.92
AMX-30-B2	0.65
"Leclerc" 1	1.80
IFV "Bradley" M2	0.55
BRM-M3 (armored recon vehicle)	0.55
"Marder"	0.26
IFV "Marder" A1(A2)	0.45
"Lux" APC w/antitank guided missile	0.26
APC w/o antitank guided missile	0.06
ANTITANK WEAPONS	
"Hot"	0.58
"Tow"	0.56
"Milan"	0.46
"Dragon"	0.32
"Vigilant"	0.24
"Jagdpanzer"	0.37
120mm Recoilless Rifle	0.14
106mm BO	0.16
90mm Recoilless Rifle	0.07
"Panzerfaust" 3	0.20

Standard Reference Weapons of Russian Manufacture

TYPE OF ARMOR & COMBAT EQUIPMENT	POTENTIAL
BMP, BTR, TANKS	
T-64A	0.88
T-64B	1.24
T-72	0.88
T-72A	1.00
T-72B	1.65
T-80	1.06
T-80B	1.65
T-80 UD	1.85
BMP-1	0.47
BMP-2	0.43
BMP-3	0.65
BMPT-T	0.88
BMD	0.47
ANTITANK WEAPONS	
"Konkurs" [AT-5 Spandrel]	0.45
"Fleyta" [AT-2 Swatter]	0.46
"Falanga" [AT-2A Swatter]	0.41
"Malyutka-P" [AT-3 Sagger]	0.39
"Fagot" [AT-4B Spigot]	0.36
"Fagot" [AT-4A Spigot]	0.32
"Shturm" [AT-6 Spiral]	0.58
100mm antitank gun MT-12	0.38
SPG-9 recoilless rifle	0.15
RPG-7B	0.07
RPG-16	0.09
RPG-7B (with tandem PG)	0.20

ANNEX A

Authors' Note: The following is an extract from student text showing the mathematical determination of low-level tactics from the 2011 Belarus National Technical University's "Combat Capabilities of the Motorized Rifle (Tank) Platoon, Subunits (Tank), and Their Calculation."[19]

1.1 Initial Data for Evaluating Fires Capabilities in Combat against Enemy Armor Vehicles

Many countries employ armaments for their militaries. These armaments include tanks, infantry fighting vehicles, armored vehicles, and antitank weapons (antitank guided missile systems, handheld, and mounted antitank grenade launchers) that possess different tactical and technical characteristics, e.g., different quality, and more importantly, modern versions of different types of equipment surpassing by two times and more the fire power, defense armor, mobility, and accuracy of rockets (warheads). For example, the modern tank T-72B surpasses T-72D because of the installation of a more perfected stabilizer, guided weapons, dynamic defense, and a more powerful engine. Installing the active defense system "Shtora" [curtain], "Drozd" [thrush] immeasurably increases their survivability (T-80UD, T-90S).

At the same time, the militaries of foreign governments are armed with combat equipment that is constantly modernized based on the combat experience of such equipment in local wars and conflicts and the use of new technology. The primary emphasis is on increasing the destructive range (kill radius), armor penetration, and crew protection. For example, the U.S. Army's BMP M2 "Bradley" is being modernized in the following ways:

- ✦ increased survivability—dynamic defense (the equivalent of armor in the front up to 550 to 650 mm) is being installed; the use of composite materials based on fiberglass to build the frame, which increases survivability by 25 percent, decreases weight by 40 percent.
- ✦ increased fire power—installation of the 40 to 50 mm automatic cannon and TOW-2(3) antitank guided missiles, and the use of more modern ammunition.

Thus, the calculation of the capabilities of combat units in combat with enemy tanks and armored vehicles must take into account the quality of the weapons and combat equipment of own troops and the troops of the enemy. This is accomplished by establishing a standard reference weapon against which every weapon and piece of military equipment is measured.

Standard reference weapon is an established value for measuring the combat potential of weapons and military equipment. Calculations use the combat potential of the T-72A tank. All other weapons and equipment (ours and foreign militaries'), such as tanks of other makes, BMPs, antitank weapons, and so on, are compared to the combat potential of the T-72A tank under the conditions of direct engagement (equal conditions) (Tables 1 and 2).

Authors' Note: Tables 1 and 2 show combat potentials (also known as coefficients of commensurability) for various North Atlantic Treaty Organization and Russian/Belarus systems.[20]

Table 1.
Combat Potential of Weapons of Foreign Militaries

TYPE OF ARMOR & COMBAT EQUIPMENT	POTENTIAL
BMP, BTR, TANKS	
M1 "Abrams"	1.47
M1 A1 "Abrams"	1.87
M60 A2	2.60
"Leopard" 1A4	0.88
"Leopard" 2	1.90
"Leopard" 3	2.80
"Chieftain" MK-5	0.92
AMX-30-B2	0.65
"Leclerc" 1	1.80
BMP "Bradley" M2	0.55
BRM-M3 (armored recon vehicle)	0.55
BMP "Marder"	0.26
BMP "Marder" A1(A2)	0.45
"Lux" BTR w/antitank guided missile	0.26
BTR w/o PTUR	0.06
ANTITANK WEAPONS	
"Hot"	0.58
"Tow"	0.56
"Milan"	0.46
"Drakon"	0.32
"Vigilant"	0.24
"Yagdpanther"	0.37
120mm BO [Recoilless Rifle]	0.14
106mm BO	0.16
90mm RPTR [reactive antitank gun]	0.07
RPG [hand-held antitank grenade launcher] "Panzerfaust" 3	0.20

Table 2.
Combat Potential of Weapons of the National Military

TYPE OF ARMOR & COMBAT EQUIPMENT	POTENTIAL
BMP, BTR, TANKS	
T-64A	0.88
T-64B	1.24
T-72	0.88
T-72A	1.00
T-72B	1.65
T-80	1.06
T-80B	1.65
T-80 UD	1.85
BMP-1	0.47
BMP-2	0.43
BMP-3	0.65
BMPT-T	0.88
BMD	0.47
ANTITANK WEAPONS	
"Konkurs" [AT-5 Spandrel]	0.45
"Fleyta"	0.46
"Falanga" [AT-2A Swatter]	0.41
"Malyutka-P" [AT-3 Sagger]	0.39
"Fagot" [AT-4 Spigot]	0.36
"Fagot" mobile	0.32
"Shturm" [AT-6 Spiral]	0.58
100mm PTP MT-12	0.38
SPG-9	0.15
RPG-7B	0.07
RPG-16	0.09
RPG-7B (with tandem PG)	0.20

In calculating the fires capabilities in combat with armored vehicles, it is also necessary to account for the coefficients of combat effectiveness (Table 3).

Table 3. Coefficients of Combat Effectiveness

TYPE OF ARMOR & MILITARY EQUIPMENT	NUMBER OF PIECES OF EQUIPMENT	COEFFICIENT OF COMBAT POTENTIAL	COMBAT POTENTIAL (NUMBER OF STANDARD REFERENCE WEAPONS)
Small arms			
AKS-74, AKS-74u, AK-74, SVD	102	0.01	1.02
RPK-74, PKM, PKT	23	0.04	0.92
GP-25 ***grenade launcher***	27	0.02	0.52
PM ***pistol***	20	0.01	0.20
Combat Potential			2.66
Tanks, BMP, BTR, C2 Veh.			
BMP-2	10	0.53	5.30
BMP-2K	1	0.53	0.53
SBR 3 ***(BRM-3k)***	1	0.03	0.03
Combat potential			5.86
Mobile ATGM, SPG, RPG			
RPG-7B	9	0.07	0.63
Combined combat potential			0.63
Total combat potential			9.15

Table 3 presents the combat potential for a standard Belarus motorized rifle company equipped with the BMP-2 Infantry Fighting Vehicle. The first block shows the combat potential of the company's small arms, machine guns, and automatic grenade launchers (2.66). The second block shows the combat potential of the 12 organic fighting vehicles (5.86) and the combat potential of the nine dismounted RPG-7 antitank weapons (0.63). The expected enemy force's combat potential can be determined from Table 1 and the standard table of organization and equipment intelligence reports.

These show the number of tanks and BMPs that can be destroyed under different battlefield conditions before our [Belarus] antitank assets (tanks, antitank weapons, BMP) sustain battlefield damages.

Using the standard set of the weapons and military equipment within combat formations, potential combat capabilities of combat formations can be calculated in advance taking into account the quality, tactical and technical characteristics, and the required amount of supply held in reserve. This will result in the maximum capability, calculated in ideal conditions, without accounting for enemy counteractions, possible losses, and so on.

Typical combat capabilities are calculated based on average, e.g. typical, conditions. Real combat capabilities are calculated in preparation for battle, when military formations receive specific combat tasks and the situational conditions in which these tasks are to be executed are known.

Real combat capabilities of a combat unit in a defensive action are understood to be quantitative and qualitative indicators that characterize the ability to repel a strike from a specific enemy force grouping and to inflict significant losses while at the same time holding a defensive area with the condition that the preservation of combat capability of friendly forces is preserved at a level at which the defense can be ensured going forward.

Real combat capabilities of a combat unit in an offensive action are understood to be quantitative and qualitative indicators that characterize the ability to destroy a certain force grouping of a defending enemy and to capture an important area (vector) in an established timeframe with the condition that the preservation of combat capability of friendly forces is preserved at a level at which the offensive can be ensured going forward.

Depending on the level of the impact of enemy actions and incurred losses, combat capability may be maintained, partially lost, or completely lost. In this instance, the combat unit—

- ✦ Maintains combat capability, having sustained personnel and combat equipment losses up to 20 percent.

- Becomes partially (limited) combat capable, having sustained losses up to 50 to 60 percent and maintains command and control.
- Completely loses combat capability, having lost command and control and sustained damage to 50 to 60 percent of forces and means.

The foundation of combat capabilities of military formations is the combat potential of these formations, which is determined based on existing armament and military equipment, and personnel with appropriate materiel resources, based on standard supply norms.

1.2 Combat Capabilities of a Company in the Defense and Their Calculation

Combat capabilities of a company in the defense are characterized by fires and maneuver capabilities and by strike capabilities during counterattacks.

Knowledge of combat capabilities allows the company commander to assign combat missions intelligently and correctly use weapons in combat.

The definition of *fires capabilities* includes the ability of the company to use its antitank assets to destroy advancing tanks and other enemy targets, and to destroy personnel using small arms and other fires assets of the enemy.

The calculation of the capabilities of a company in combat with enemy armored vehicles during defensive combat is based on the use of the combat potential of armor and combat equipment and the coefficients of combat effectiveness of antitank weapons in different types of combat.

The capabilities of a company are expressed through the number of tanks and BMPs, the attack of which must be repelled while maintaining its combat effectiveness, e.g., without losing more than 50 percent of its forces and means and retaining command and control.

To Destroy Tanks:

$$Kt = (BPbmp + BPrpg) \times Ke/BPptr$$

To Destroy BMPs:

$$Kbmp = (BPbmp + BPrpg) \times Ke/(BPbmp\ pr + BPptrk\ pr)$$

Company fires capabilities in battle with enemy armored vehicles can be calculated using the following formula:

where

- *Kt, Kbmp* represent the number of enemy tanks (BMP) that can be destroyed.
- *BP, BPpr* are the combat potential (CP) of the weapons and equipment in force-on-force [duel] combat of our side [BP] and the enemy [BPpr] according to the different CP types (BPbmp, BPrpg, BPbmp pr, BPptrk pr). ***Infantry fighting vehicles= bmp, shoulder-fired antitank weapons =rpg, ptrk=antitank guided missiles (ATGM), pr=enemy***.
- *Ke* is the coefficient of effectiveness of weapons in force-on-force [duel] combat.

1.3 Defensive Combat Capabilities of a Platoon and Their Calculation

Knowledge of combat capabilities allows the platoon commander to assign combat missions intelligently and correctly use weapons in combat.

The definition of fires capabilities includes the ability of the platoon to use its antitank weapons to destroy advancing tanks and other armored enemy targets, and to destroy personnel using small arms and other fires assets.

To Destroy Tanks:

$$K_T = 0.7(\Sigma BP_{Ni}) \times Ke \times K_{PN}/BP_{Tpr}$$

To Destroy BMPs:

$$K_{BMP} = 0.3(BPbmp \times Nbmp + BPrpg \times Nrpg) \times Ke \times K_{PN}/(BP_{BMPpr} + BP_{PTRKpr})$$

Platoon fires capabilities in battle with enemy armored vehicles can be calculated using the following formula:

where

- *0.7* is the portion of force-on-force [duel] combat weapons necessary for defeating enemy tanks (value obtained through trials).

- *0.3* is the portion of force-on-force [duel] combat weapons necessary for defeating enemy BMPs (value obtained through trials, meaning that 70 percent of fires will be used for fighting tanks and 30 percent with enemy BMPs).
- *Ni* is the number of friendly force-on-force [duel] combat weapons, according to their type (MT—tanks, Kbmp—BMP, Mrpg—RPG, and others).
- K_T, K_{BMP}–number of enemy tanks (BMP), which can be defeated, per weapon.
- BP_{pr} (enemy), *BP* are the combat potentials of the weapons in force-on-force [duel] combat of each side by type, per weapon.
- *Ke* is the coefficient of effectiveness of force-on-force combat weapons under different conditions, per weapon.
- K_{PN} is allowable level of losses, per weapon/personnel.

2. Methodology to Evaluate Company Capabilities to Repel the Enemy using Small Arms Fire

The mathematical expectation of damage inflicted on enemy personnel is the primary indicator of the capabilities of the platoon to repel the enemy using small arms fire.

The calculation is based on comparing the density of small arms fire of the opposing sides, expressed as the number of bullets per 1 meter of the front in a specified sector of fire in a given timeframe (1 minute).

The density of fire depends on the number of weapons, weapons types, rate of fire, and width of the area within which the fire is conducted.

The sequence of calculating company fire capabilities to repel the enemy using small arms fire is the following:

1. Calculate the number of automatic rifles, machine guns, and other small arms and their total combat rate of fire:

$$\Sigma BS_{VZ} = Ka \times BSa + Kp1 \times BSp1 + Kp2 \times BSp2 + Kp3 \times BSp3 + K_{SVD} \times BS_{SVD}$$

where

- ΣBS_{VZ} is the total combat company rate of fire.
- Ka—number of automatic rifles in a company.
- Kp1—number of machine guns RPK-74 in a company.
- Kp2—number of PKT [antitank Kalashnikov] machine guns in a company.
- Kp3—number of PKM [modernized Kalashnikov] machine guns in a company.
- K_{SVD}—number of SVD [Dragunov sniper rifle] in a company.
- BSa—combat rate of fire for automatic rifles.
- BSp1—combat rate of fire for RPK-74.
- BSp2—combat rate of fire for PKT.
- BSp3—combat rate of fire for PKM.
- BS_{SVD} –combat rate of fire for SVD.

2. Determine the total combat rate of fire considering personnel and weapons losses during enemy fire preparation actions (up to 20 percent):

$$\Sigma BS_{VZ}P = \Sigma BS_{VZ} \times 0.8$$

3. Determine the width of the front of company fire support (ShF):

$$Sh_F = F + 0.5(P1 + P2)$$

where

- Sh_F is front width of a unit's fire support, in meters.
- F is the front of platoon stronghold, in meters.

✦ Sh in P2 are the distances of separation between neighboring units, in meters.

4. Calculate small arms fire density (PlOSO) per 1 meter of the front in 1 minute considering losses, N bullets/meters (number of bullets per one meter of the front):

$$PlOSO = \Sigma BS_{VZ}/Sh_F$$

5. Determine enemy forces, which can advance toward the front of the company's fire support operations, calculating their total combat rate of fire and fire density per 1 meter of front considering losses (10 percent) sustained from artillery fire (similar method).

6. Compare friendly and enemy fire density, and draw conclusions.

Example calculation of fire capabilities of motorized rifle platoon [*msv*] on BMP using small arms fire to repel the enemy.

A motorized infantry company has AK-74—90 rifles, RPK-74—9, PKM—3, PKT—3, SVD—12.

1. Calculate the number of automatic rifles, machine guns, and other fires methods and their total combat rate of fire ΣBS_{VZ}:

$$\Sigma BS_{VZ} = 90AK \times 100 + 9RPK \times 1501 + 1PKM \times 250 + 3\ PKT \times 250 + 12SVD \times 30 = 12210/minute$$

2. Determine the total combat rate of fire considering personnel and weapons losses during enemy fire (up to 20 percent):

$$\Sigma BS_{VZ} = 0.8 \times 12210 = 9768/minute$$

3. Determine the front width of company fire support (Sh_F):

$$Sh_F = 1500 + 0.5(500+500) = 2000\ meters$$

4. Calculate small arms fire density (PlOSO) per 1 meter of front in 1 minute considering losses:

$$PlOSO = 9768/2000 = 5\ bullets\ per\ minute\ per\ 1\ meter\ of\ front$$

5. Determine fire density of enemy forces per 1 meter of front considering losses (10 percent) from artillery fire:

Up to 2 motorized antitank units can advance within a 2000-meter front.

$$PlOSO = ((120M16 \times 100 + 36M249 \times 150 + 18M60 \times 250 + 24P_{BMP} \times 250) \times 0.9)/2000 = 13\ bullets\ per\ 1\ meter\ of\ front$$

6. Compare fire densities 13/5 = 2.6 (enemy fire density is 2.6 times greater).

Successful achievement of a combat objective is possible with a ratio of 3:1 and lower. In this instance, the established density of 3 to 5 bullets per minute per 1 meter of front supports a 50 percent defeat rate of advancing enemy infantry forces, and upon taking decisive action, the platoon can create the fire density of up to 15 bullets per minute, which supports an 80 to 90 percent defeat rate of attacking enemy infantry troops.

Thus, a motorized rifle company in the defense, using standard weapons and BMPs, is able to create fire density of over 3 bullets per minute per 1 meter of front (considering 30 percent losses), which is necessary to guarantee 50 percent losses against an enemy with three times the infantry force and to successfully repel attacks along the 2000 meter front with fire support.

It is most appropriate to calculate combat capabilities with the following conditions: level of enemy losses in an attack—0.35 (enemy refuses to continue the attack) and level of friendly defensive force losses—0.5 (combat capability limited).

Example calculation of platoon fire capabilities in a fight with enemy armored vehicles.

Initial data is BMP—3, RPG-7—3, M1 "Abrams"—3, IFV M-2 "Bradley"—4, ATGM "Drakon"—3.

Composition of motorized infantry platoon—3 BMP.

Tank platoon—3 tanks.

Calculating the fire capabilities of a platoon in a fight with enemy armored vehicles:

$$Kbmp = 0.3(BPbmp \times Nbmp + BPrpg \times Nrpg) \times Ke \times Kpn/(BP_{BMPpr} + BP_{PTRKpr})$$

$$Kbmp = 0.3(0.53 \times 3 + 0.07 \times 3) \times 3 \times 0.5(0.55 + 0.32) = 2.8 \text{ (three IFV)}$$

$$Kt = 0.7(\Sigma BP_{Ni}) \times Ke \times (K_{PN}/BP_{Tpr}) = 0.7(0.5 \times 3 + 0.7 \times 3) \times 2 \times 0.5/1.47 = 0.86 \text{ (up to 1 tank)}$$

Thus, the motorized rifle platoon in the defense is able to defeat 3 IFVs during defensive operations and 1 tank, while maintaining the platoon's combat capability (losses no more than 50 percent).

Example calculation of fire capabilities of a motorized rifle platoon in repelling the enemy using small arms fire.

Motorized rifle platoon has AK-74—22, RPK-74—3, PKM—1, SVD—4.

1. Calculate total combat platoon rate of fire ΣBS_{VZ}:

$$\Sigma BS_{VZ} = 22AK \times 100 \text{ per minute} + 3RPK \times 150 \text{ per minute} + 1PKM \times 250 \text{ per minute} + 4SVD \times 30 \text{ per minute} = 3020 \text{ per minute}$$

2. Determine total combat platoon rate of fire considering losses during period of enemy fire preparation (losses up to 20 percent):

$$\Sigma BS_{VZ}P = \Sigma BS_{VZ} \times 0.8 = 3020 \times 0.8 = 2416 \text{ per minute}$$

3. Determine width of the front of fire support of the platoon:

$$Sh_F = F + 0.5(P1 + P2) = 400m + 0.5(300m + 300m) = 700m$$

4. Determine small arms fire density per 1 meter of front in 1 minute considering losses:

$$PlOSO = \Sigma BS_{vz}/ Sh_F = 2416/700 = 3.45 \text{ bullets per minute per 1 meter of front}$$

5. Calculate enemy fire density per 1 meter of front considering losses from friendly artillery fire (up to 10 percent).

Up to 2 motorized infantry platoons and 1 to 2 tank platoons, which are capable of producing fire density of 13 bullets per minute per 1 meter and more (excluding tank machine guns) can attack along a front of 700 meters.

$$PlOSO_{pr} = ((44M16 \times 100 + 12M249 \times 150 + 6M60 \times 250 + 8P_{BMP} \times 250) \times 0.9)/700 = 12 \text{ bullets per minute per 1 meter of front}$$

6. Compare fire densities 12/3 = 4:1.

Using Table 4, we find the correlation of 4:1 and determine that the platoon, in the defense and under given conditions, can damage the enemy by 30 percent, while sustaining 84 percent losses of friendly personnel. Successful achievement of combat objectives is possible with this ratio and less. In this case, the established density of 3 to 5 bullets per minute per 1 meter of front supports a 50 percent defeat rate of advancing enemy infantry forces, and upon taking decisive action, the platoon can create the fire density of up to 15 bullets per minute, which supports an 80 to 90 percent defeat rate of attacking enemy infantry forces.

This way, the BMP motorized rifle platoon in the defense, using regular weapons and BMPs, is capable of producing fire density of 3 bullets per minute per 1 meter of front (considering 20 percent losses). This is necessary to guarantee 50 percent losses in an enemy with three times the infantry force and to repel attacks successfully along a 700m fire support front, while defending the stronghold along a front of up to 400 meters.

Table 4. Losses of Offensive and Defensive Sides Depending on the Correlation of Forces and Means

TIME OF DAY	SPEED OF OFFENSIVE KM/H	SIDES	LOSSES BASED ON GIVEN FORCE AND MEANS CORRELATIONS BY PERCENTAGE					
			1:1	2:1	3:1	4:1	5:1	6:1
DAY	5	Offense	100	88	49	**30**	18	10
		Defense	20	28	56	**84**	100	100
	10	Offense	100	41	30	20	15	11
		Defense	60	20	33	46	60	73
NIGHT	5	Offense	100	62	37	26	18	13
		Defense	30	24	42	60	77	85
	10	Offense	70	33	21	15	11	9
		Defense	60	15	14	32	41	49

Endnotes

1. Russian Ministry of Defense, "Соотношение Сил N Средств" [Correlation of Forces and Means], *Военная Энциклопедия* [Military Encyclopedia], Volume 7 (Moscow: Voyenizdat, 2003), 583.

2. Michael Chichenski, "Soviet Correlation of Forces and Means" (class lecture, U.S. Army Russian Institute, Garmisch, Germany 1982).

3. Photo by Vyacheslav Argenberg / http://www.vascoplanet.com/, edited by MIPB Staff.

4. Russian Ministry of Defense, *Учебно-методические Материалы по предмету Тактическая Подготовка* [Teaching and Methodological Materials for the Subject of Tactical Preparation] (Barnaul: Altai State Technical University by I. I. Polzuno, 2017), 24; Russian Ministry of Defense, *Боевый Устави* [Combat Regulations] (Moscow, 2014), 7; and I. N. Vorobyev, *Тактика- искусство боя* [Tactics: The Art of Combat] (Moscow: Combined Arms Academy of the Russian Federation, 2002), 70, 117, 199, 212, 228, 232, 233, 279, 289, 357, 359, 616, 634.

5. Qualimetry assesses the quality of a commodity, service, or system. Quality is defined as the "aggregate of properties…associated with the result of consuming the object." Clint Reach, Vikram Kilambi, and Mark Cozad, *Russian Assessments and Applications of the Correlation of Forces and Means* (Santa Monica, CA: RAND Corporation, 2020), 71.

6. Ibid., 72–73.

7. V. N. Dorokhov and V. A. Ischuk, "Combat Potentials of Subunits [Battalion-Level] as an Integral Criterion for Assessing Combat Capabilities of Combat Formations and Combat Effectiveness of Arms and Military Equipment," trans. Clint Reach, *News of the Russian Academy of Missile, Rocket, and Artillery Sciences* [RARAN] 4, no. 99 (2017): 27–36.

8. Ibid.

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10. Ibid.

11. V.A. Valezhanin and A.A. Tarchishnikov, *Боевые вожмосноти мотострелкого (танкого) взвода, отделение (танка) и их расчет* [Combat Capabilities of the Motorized Rifle (Tank) Platoon, Subunits (Tank), and Their Calculation] (Minsk: Belarus National Technical University, 2011).

12. Ibid., 4.

13. Ibid., 4–5.

14. Chichenski, "Soviet Correlation of Forces and Means."

15. Reach, Kilambi, and Cozad, *Russian Assessments and Applications*, 94.

16. Vorobyev, *Tactics: The Art of Combat*, 633–634.

17. Lester W. Grau and Charles K. Bartles, *The Russian Way of War: Force Structure, Tactics and Modernization of the Russian Ground Forces* (Fort Leavenworth, KS: Foreign Military Studies Office, 2018), 58, https://community.apan.org/wg/tradoc-g2/fmso/p/fmso-bookshelf.

18. William Shakespeare, *The Tempest*, act 2, sc.1.

19. Valezhanin and Tarchishnikov, *Combat Capabilities*.

20. Comments in bold italics in Annex A are the authors' explanatory notes.

Dr. Lester Grau is a Vietnam veteran, Soviet foreign area officer, retired U.S. Army lieutenant colonel, and currently the research coordinator for the Foreign Military Studies Office, Fort Leavenworth, KS. He holds a bachelor's degree and master's degree in international relations and has a doctorate in military history. He is also a graduate of the U.S. Army Defense Language Institute (Russian) and the U.S. Army's Institute for Advanced Russian and Eastern European Studies. He is the author of 13 books and more than 250 published articles.

Mr. Clint Reach is a policy analyst at the RAND Corporation. He holds a bachelor's degree in management information systems and a master's degree in political science from Kansas State University. He also holds a master's degree in Russian and Eurasian studies from Johns Hopkins University School of Advanced International Studies. Mr. Reach served for 9 years in the U.S. Navy as a Russian linguist. Before joining RAND in 2015, Mr. Reach worked for a short time at the Office of the Secretary of Defense for Policy–Russia, Ukraine, and Eurasia.