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RUSSIAN ELECTRONIC, INFORMATION, NAVIGATION, AND RECONNAISSANCE-STRIKE AND -FIRE OPERATIONS: DEFINITIONS AND USE

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Military security is turning into an intellectual-reconnaissance-informational-navigational-strike system, which demands a special relationship regarding the control of its actions.

Major General (deceased) V. D. Ryabchuk, 2008[1]

Introduction

Russia has been investigating a host of strike and fire concepts for at least a few decades, with one of the first reconnaissance-strike discussions documented in 1984. The quotation above indicates that reconnaissance-strike is not the only strike means under consideration in Russia, and that the number has increased over the years. In terms of terminology and context, Russia's strike and fire forms are different from those of other nations. The forms under discussion in Russia are radio-electronic-strikes (REU) and radio-electronic-fire strikes (REOU), information-strike and -fire operations (IUO for strike operations, no abbreviation offered for -fire operations), remotely controlled cyber operations (RCW, which appear to be part of information-strikes), navigation strikes, and reconnaissance-strike[2] and -fire complexes (RUK and ROK, respectively).

Most of these points were further emphasized during General Staff Chief Valery Gerasimov's 2018 presentation to the Academy of Military Science. He stated the following:

> Recce-strike and recce-fire profiles are being created with the aim of ensuring the efficiency and continuity of fire effects against the enemy. Reconnaissance-information and information-control systems are being integrated with weapons systems of services and branches. Work is being done on the creation of an automated interservice recce-strike system.
>
> Considering the steady broadening of the scope of employment of different types of radio-electronic means, forces and means of struggle against them are being developed. Forces are being outfitted with equipment for radio-electronic warfare against aerospace resources, navigation systems, and digital radio communications systems.[3]

RUK and ROK operations have been the center of most strike and fire discussions over the years. IUO and information-fire operations have been discussed more intermittently in military periodicals (2007, 2009, 2011, and 2020). In 2009 information-strike systems (IUS) were added to the discussion. The REU and REOU were introduced in 2017 (perhaps earlier, just undocumented) and they work to disorganize an opponent's command and control capability (C2).

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[1] V. D. Ryabchuk, "Problems of Military Science and Military Forecasting in Conditions of an Intellectual-Information Confrontation," *Voennaya Mysl' (Military Thought*), No. 5 2008, p. 73.

[2] General definitions of strike and fire are: Udar (strike): strategic, operational, or tactical in scale and can be nuclear or conventional. Ogon (fire): artillery, tanks, small arms, etc. use of weapons to damage or destroy targets in combat. See pages 762 and 508, respectively, of the *Military Encyclopedic Dictionary*, Moscow Military Publishers, 1986, main editor was S. F. Akhromeev.

[3] V. V. Gerasimov, "The Influence of the Contemporary Nature of Armed Struggle on the Focus of the Construction and Development of the Armed Forces of the Russian Federation. Priority Tasks of Military Science in Safeguarding the Country's Defense," *Vestnik Akademiy Voennyh Nauk (Journal of the Academy of Military Science)*, 2018, No. 2, p. 19. The author would like to thank Dr. Harold Orenstein for his translation of this presentation.

The 2017 article discussed below used the term "disorganization" 18 times. Remote-controlled cyber operations first appeared in 2015 and then again in 2020, both times authored by the same individual. Navigation strikes were apparently exercised against the NATO Trident Juncture exercise in 2018. The inclusion of the term in Gerasimov's presentation indicates the issue is more important than previously viewed.

The following summary of these four fire and strike operation classifications covers the period from 1984 to the present. Due to their shorter length, the examination first looks at the REU and REOU concepts and how they assist in the attainment of superiority over opponents during operations and create favorable conditions for seizing and keeping the operational (tactical) initiative.[4] Second, the discussion examines Russian information-strike operations, to include the use of remote-cybernetic operations and, to some authors, the use of radio-electronic means as well. The remote-cybernetic weapons have been described as smart weapons and thus are included in the information-strike section. Third is a very short discussion of a Russian navigation strikes against NATO forces during exercise Trident Juncture. Finally, there is a long and extended discussion of RUK and ROK operations.

Based on this detailed analysis, Russia is clearly continuing to look for new ways to utilize strike and fire means. Artificial intelligence and robotics are part of current ways to update and improve reconnaissance-strike and -fire complexes. There are two appendixes. The first one is on definitions and the second one is a diagram of a ROK from a Russian publication.

The Radio-Electronic Strike Concept in 2017

In 2017, an important article on radio-electronic warfare (REB) appeared in the journal *Military Thought*. It stated that there were two important Russian REB developments in the initial decade of the 21st century, first the creation of REB troops and second the documented guidance for REU and REOU operations, whose theoretical components had been discussed as early as the 1990s.[5]

The authors listed the following fundamental principles as the template to follow when using REU or REOU (to stress the apparent importance of the **disorganization** concept in this article, each time the term is addressed it is placed in **bold** below).:

- The object of the strike: practically the entire range of resources of an opponent's information-control systems (ICS) are potential targets of suppression. For example, communications centers may be an object of REU to cause "radio-information blocking" of the unit and its entire C2 subunits (forward and rear command posts, etc.).[6]

[4] D. V. Kholuenko, V. A. Anokhin, A. S. Korobeynikov, and L. A. Lakhin, "Radio-Electronic and Radio-Electronic-Fire Strikes—Basic Forms of Employing REB Unites and Subunits," *Voennaya Mysl' (Military Thought*), No. 11 2017, pp. 21, 27. The author would like to thank Dr. Harold Orenstein for the translation of this article.

[5] For example, one of the articles authors, V. A. Anokhin, had written an article in *Nauchnyi Sbornik (Scientific Journal*) in 1993 titled "New Forms and Methods for the **Disorganization** of Enemy Command and Control of Troops and Weapons in Operations and Combat Operations." See page 21 for the entire site.

[6] Kholuenko, Anokhin, Korobeynikov, and Lakhin, p. 22.

- The target of the strike: the disruption of the functioning of an ICS or line of enemy leadership, with a "given degree of effectiveness for the **disorganization** of C2" or "the functioning of information systems."[7]
- The strike's effectiveness: the REOU goal is to **disorganize** the functioning of enemy C2 with a concentrated main effort. If capacity is limited, then **disorganize** the C2 of first-echelon brigades. If capacity is adequate, then **disorganize** C2 subsystems, such as field artillery and tactical or army aviation.[8]
- The force requirements to deliver REU and REOU: the range of resources for interference must span all types of communications. The absence of even one interference type results in a 2-3-fold reduction in the effectiveness of **disorganizing** C2.[9]
- The place to insert the REU (REOU) in an operation: at the beginning of an operation, an REOU is delivered to **disorganize** C2 of first-echelon troops and an REU is delivered to **disorganize** the C2 of field artillery. As the operation develops, strikes aim to **disorganize** the C2 of an opponent's second echelon and reserves. **Disorganizing** C2 ensures the seizure of the operational initiative.[10]
- The procedure for employing forces and means: it is necessary to preempt an opponent's use of C2 and REB systems; jamming stations should leave a position after 5-15 minutes; and strikes should be comprehensive.[11]

Based on these distinctions, the following REU and REOU definitions were offered:

Radio-electronic strike – the comprehensive and mass employment of radio-electronic warfare forces and means, coordinated with troops tasks, for the purpose of ensuring the required effectiveness for the **disorganization** of the enemy's information-control systems (control systems) or the lines of enemy leadership.
Radio-electronic-fire strike – the totality of specially organized radio-electronic and fire strikes, coordinated and interconnected with respect to goals, tasks, place, and time, conducted by the forces and means of various services and special forces, according to a single concept and plan to execute tasks for the **disorganization** of enemy command and control of troops and weapons on given axes, in an established period and with the assigned effectiveness.[12]

The following table shows units and subunits needed to deliver an operational REU or REOU. The table was listed under the bullet "force requirements" above:

Table 1: Participation of REB Units and Subunits in Delivering REU or REOU at Different Levels[13]

[7] Ibid., p. 23.
[8] Ibid., p. 24.
[9] Ibid.
[10] Ibid., p. 25.
[11] Ibid.
[12] Ibid., p. 26.
[13] Ibid., p. 24.

Level of REU or REOU	Participation of REB Units and Subunits			
	MRB	Army	Military District	Central Subordination
Strategic			+	+
Operational-strategic		+	+	+
Operational	+	+	+	+
Tactical	+	+	+	

The following comment ended the discussion on force requirements:

> The accumulated experience of assessing the effectiveness of **disorganizing** command and control at the tactical and operational-tactical levels of an opposing side confirms that to achieve a tangible effect of **disorganizing** command and control without the fire destruction of the enemy's radio electronic resources requires a capacity of REB resources that exceeds the existing capacity in large formations (formations) by 2.5-3 times.[14]

Thus, an increase in Russian REB systems is expected. To close out the article, the authors listed the parameters of REU and REOU for an army operation and division battle as follows:

Table 2: General Characteristics of Army and Division (Brigade) REUs and REOUs[15]

Number	Characteristics	Forms of REB Employing Units and Subunits			
		Army operation		Division (brigade) battle	
		REU	REOU	REU	REOU
1	Object of effects	Line of leadership of the type army corps (AK)-first-echelon motorized division (md), AK-reserve md, etc.	AK's information-control system (ICS), AK's functional systems	Line of leadership of the type first echelon md-motorized brigade (mbr)-motorized battalion (mb), md-fire control center, etc.	Md, mbr ICS, md functional systems
2	Goal	**Disorganization** of command and control of first-echelon divisions for the time for executing operational task	Gaining superiority in command and control at the operational level for the time for executing operational task	**Disorganization** of command and control of first-echelon formations (units) for the time for executing operational task	Gaining superiority in command and control at the tactical level for the time for executing operational task
3	Anticipated effectiveness (degree of **disorganization**)	Breakdown of command and control of first-echelon formations (units)	1. Breakdown of command and control while executing an operational task 2. Gaining (maintaining) superiority in command and control	Breakdown of command and control of first-echelon formations (units)	1. Breakdown of command and control at the md-mbr-mb levels while executing an operational task 2. Gaining (maintaining) superiority in command and control
4	Place in the operation (battle)	Component of army operation or REOU army	Component of army operation	Component of Division (brigade) battle or division (brigade) REOU	Component of battle

[14] Ibid., pp. 24-25.
[15] Ibid., p. 26-27.

5	Decision-making level	Army chief of staff on recommendation of REB chief	Army commander on recommendation of REB chef	Formation chief of staff on recommendation of REB chief	Formation commander on recommendation of REB Chief
	Scope	One line of corps leadership	AK ICS, 1-2 AK functional systems	One line of division leadership or 1-2 lines of brigade leadership	MD ICS, 1-2 MD and/or MBR functional systems
	Frequency	1-2 times per day of operation (battle)			
	Duration, hours	1-2	1.5-3	0.5-1.5	1-1.5
6	Depth and width	In the zone of army defense to a depth of the enemy's operational structure		To the entire depth of the enemy's combat formation in the brigade's area of responsibility	
7	Make-up of forces being used	Forces and means of special operations, rocket forces and artillery, army aviation, operational-tactical aviation, and REB of the military district, army, division (brigade)			

The article's final thoughts recommended finding new forms for **disorganizing** enemy C2 as a priority trend for military researchers.[16] While a 2017 article, the content remains important today.

Information-Strike/Remote-Controlled Cyber Weapons in 2007, 2009, 2011, 2015, and 2020

By 2007, the information age's impact on operations was in full display in Russia and elsewhere. Instead of the reconnaissance-strike operation (ROO) concept, I. N. Vorobyev, a specialist in tactical issues, discussed the evolving field of information-strike operations (IUO) in the journal *Military Thought*. The informatization of the Russian Armed Forces had created opportunities for information attacks on command-and-control targets. Of interest is that Vorobyev underscored how C2 can be "**disorganized**" in both physical and electronic ways, with the latter becoming an "active offensive weapon as effective as firepower."[17] An IUO was defined as

> The sum total of interconnected information-fire engagements, information-fire battles, and information strikes, coordinated in terms of target, objectives, place, time, and methods, and conducted to **disorganize** an adversary's troop and weapon command and control and inflict a blow to its information resources.[18]

It was suggested to use the IUO in combination with firepower.

An information-strike, Vorobyev added, is a short and powerful attack by an information weapon on an opponent's information resource. Types include information and psychological strikes to disinform and mislead an adversary; psychotropic strikes, which affects people's minds with special tools; electronic, which includes jamming (and calls into question whether information and electronic strikes are in the same category—he makes a case that they are); and software, which includes attacks on an opponent's C2 computers. IUO's make it possible to seize the initiative and gain information superiority, to reflexively control an opponent, and to be carried out independently or in combination with other operations.[19] IUOs are global, varied in form and method, continuous, and covert, allowing for fast-moving and precise operations. While the scope of an IUO has not been yet determined, to Vorobyev it could extend along an operational axis

[16] Ibid., p. 27.
[17] I. N. Vorobyev, "Information-Strike Operations," *Voennaya Mysl' (Military Thought*), No. 6 2007, p. 15.
[18] Ibid.
[19] Ibid.

exceeding 300-400 kilometers laterally and up to 450-500 kilometers in depth. An entire theater of operations would be covered on the strategic level.[20]

The IUO consists of three stages, the **disorganization** of an opponent's intelligence capability to increase surprise; under cover of jamming, deliver strikes to kill assets; and the **disorganization** of information support of all combat operations. Blocking the gathering, processing, and sharing of information, and the planting of disinformation at all stages of information support, is required.[21] Full use of precision weapons is made to **disorganize** adversary information management systems of artillery and aircraft. It is possible that future wars will involve electronic-fire battles and electronic-fire engagements used by different types of EW units.[22] The latter appeared to have evolved as he predicted, based on the 2017 REB discussion above on the electronic-fire concept.

Finally, coordination is required to accomplish the following objectives, all designed to protect Russian assets:

1. Counter adversary reconnaissance
2. Conduct jamming, wage information and fire battles, and deliver concentrated and massive information strikes
3. Launch an information-psychological attack to disinform and mislead the adversary
4. Attack adversary command and control computers with special destructive or corruptive software
5. Seize (destroy) adversary intelligence forces and assets, command posts, radars, and communication centers
6. Conduct camouflage, simulation, disinformation, and feints to create a false electronic environment
7. **Disorganize** adversary information management systems, information support of reconnaissance, combat zone air and missile defense, tactical and army aircraft, and field artillery
8. Disrupt information support of fire forces and assets.[23]

Vorobyev added that it will be necessary to maneuver EW forces and covertly shift electronic strikes from one site to another. It will be necessary to simultaneously carry out electronic attacks against EW sites or blockade them both electronically and with fire. These are offensive operations.[24]

In 2009, the information-strike system (IUS) was introduced, although the IUO continued to be defined and discussed as well. The IUS was the result of the reconnaissance-strike complex acquiring a "new quality." The information-strike system (IUS, range over 500 kilometers, in the strategic zone) is an automated weapon system designed for the highly effective destruction of one, several, or many facilities/targets using

[20] Ibid., p. 17.
[21] Ibid., pp. 17-18.
[22] Ibid., pp. 19-20.
[23] Ibid., p. 21.
[24] Ibid.

precision-guided strike weapons at great distances in accordance with the operations plan or its concept of operations.[25]

These changes in range and accuracy were made possible by the availability of satellites and other means of information-space support. This support allows for accurate target acquisition while Russian units remain outside of the kill zone of the enemy's traditional weapons. It also minimizes the importance of the old concept of theaters of military operations that were carved out under geographic considerations. Further, the interface between missiles and space-based systems that improves range and accuracy is not restricted in any manner by existing treaties. Past arms control treaties have only addressed the number of missiles, their flight range, and speed.[26]

The sequence of operations in future wars, the authors noted, will start with a preemptive information war to gain supremacy in political, legal, psychological, and other non-military measures. Space operations will then precede air, naval, and land offensive operations directed at gaining supremacy in near-Earth space to ensure the functioning of Russia's orbital constellations. The main missions of space operations will be to destroy an enemy's space infrastructure and to disrupt their command and control. Once the supremacy of space information systems and independent military operations is assured in strategic space (meaning offensive missions will predominate to gain the initiative in war), it is then possible to consider defensive operations to defend information resources.[27]

These missions will be accomplished through the information-strike operation (IUO). The IUO is:

> The sum total of interrelated and coordinated operations based upon goals, missions, location, time, and techniques for the conduct of information-strike battles, information-weapon engagements, and information-strikes which are being conducted with the goal of disrupting the enemy troops command and control and weapon control systems and the destruction of his information resource. This is a new form of armed combat, the characteristic elements of which are information-strikes which transition in combination with fire impact into information-weapon engagements and information-strike battles.[28]

The IUO will be important in helping Russian forces gain the initiative in the information sphere. This ensures troop and weapon complex command and control as well as reflexive command and control of the enemy. The latter concept enables the management and control of adversary battlefield perceptions. The striking importance of this concept should not be overlooked since Russia's military is considering operational-strategic strike operations against the information infrastructure and resources of potential adversaries. Russia's desire to use the IUO as a reflexive control mechanism that manages the perceptions of enemy forces is an issue worthy of future study.

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[25] Igor Morozov, Sergey Baushev, and Oleg Kaminskiy, "Space and the Character of Modern Military Activities," *Vozdushno-kosmicheskaya i Oborona (Air and Space Defense*), No. 4, 2009, pp. 48-56, downloaded from the Eastview web site.
[26] Ibid.
[27] Ibid.
[28] Ibid.

In **2011**, two Russian military specialists wrote on information-strike operations in the journal *Armeyskii Sbornik (Army Journal)*. They viewed the classic triad of fire, strike, and maneuver as no longer capturing the essence of a battle or operation. Radio-electronic, electronic-fire, and information-strike operations were the new forms of armed struggle, they noted. The latter is defined below:

> The information-strike operation (IUO) is the totality of mutually associated information strike engagements (*srazhenie*), information-strike battles (*boi*), and information strikes (*udar*), coordinated with respect to goal, missions, place, time, and method of conduct, carried out with the aim of disorganizing an adversary's troop and weapons command and control system and destroying his information resources.[29]

The definition is almost identical to the first part of the IUO definition offered above in the 2009 discussion. The types of strikes include information-psychological (which disinform or mislead an adversary), information-psychotropic (to disrupt a person's psyche), radio-electronic, and program-computer. IUO's help gain the initiative and superiority in the information sphere, including command and control of troops and the reflexive control of opponents. IUO's have no spatial limitations, a variety of forms and methods of use, no weather or seasonal constraints, can often be used covertly, and can target command posts and communication nodes.[30]

IUOs can be conducted in three stages. First, information support systems of command and control for intelligence, air defense, and rocket defense are **disorganized**. Second, under the cover of jamming, destructive strikes are made—operational-tactical and tactical rockets. Third, information support of tactical and army aviation and field artillery is **disorganized**.[31] To prepare an IUO, an adversary's command and control system must be studied and exposed, and objectives for fire and radio-electronic destruction determined in advance. **Disorganizing** the enemy's command and control system is critical to planning and coordinating friendly fire destruction elements.[32]

The authors appear to have combined the two articles above, Vorobyev's 2007 discussion in *Military Thought* and Morozov, Baushev, and Kaminskiy's 2009 article in *Air and Space Defense*. They note that there are various types of information-psychological weapons that will enhance an IUO. This involves energy-information-psychological weapons under study that look for ways to modulate super high frequency ultrasonic infrared waves that affect the human nervous system. S. G. Chekinov and S. A. Bogdanov mentioned the use of infrasonic weapons in their 2015 article on forecasting in *Military Thought*. There have been several authors who discussed Russia's use of nonlethal weaponry. Psychotropic-information weapons use narcotics and chemicals to produce information-control effects on biological processes and the nervous system. Technical means (e.g.,

[29] I. N. Chibisov and V. A. Vodkin, "The Information-Strike Operation," *Armeyskii Sbornik (Army Journal*), March 2011, p. 46. The author would like to thank Dr. Harold Orenstein for the translation of this article.
[30] Ibid., pp. 46-47.
[31] Ibid., p. 47.
[32] Ibid., p. 48.

generators) of virtual information-psychological and other types of weaponry offer different potential capabilities to affect the human psyche (author's note: no actual results were offered, just these theories). Information-psychological weapons are to be integrated with fire, radio-electronic, and energy effects to broaden the operational-strategic methods for achieving IUO goals. Radio disinformation, active and passive jamming, false radar targets, and fake communication centers facilitate misleading an opponent. The IUO is basically an offensive action, but it can acquire a defensive character if needed.[33]

In a 2015 *Armeyskiy Sbornik (Army Journal*) article, titled "Remote-Controlled Cyber Weapons: Construction Principles and Functional Possibilities," author G. Vokin discussed this new type weapons military-technical capabilities, organizational composition, and expected effects.[34] Interestingly, the August 2020 issue of Russia's *Military Thought* included another Vokin article on the same topic, but coauthored this time with M. I. Makarov. It was titled "The Conceptual Foundations of the Creation of a New Class of Weapon—Remote Cybernetic Weapons."[35] While not directly using the terms strike and fire, the implication was clear: this is how cyber weapons would be used in operations, to include in reconnaissance-diversionary operations.

In the 2020 article, remote-cybernetic weapons (RCW) were discussed and appeared to be another way of discussing smart weaponry (use of lasers, etc. for precision targeting). RCW are composed of a series of new capabilities. Due to the speed (to include hypersonic) and precision of these weapons, they can overcome counter-systems. RCW are non-nuclear "smart weapons," the authors noted, based on robotics, artificial intelligence (AI), and information resources which guarantee high strike accuracy on critically important elements of targets. It is combat robot-fighters that deliver RCW to the target area, not classical missiles, and bombs.[36]

The authors called it wise to remotely destroy an opponent's strategic weapons and the most important military and civilian structures. However, ballistic-type warheads are in the field of vision of air defense systems for their entire flight and thus have a more limited chance to destroy an opponent's nuclear sites. This is due to the difficulty of hitting an enemy's nuclear potential that is often hidden on reverse slopes of mountains or in canyons. Thus, hitting large cities and important stationary structures (military bases, arsenals, large hydroelectric stations etc.) become main targets. Cruise warheads offer a way out of this dilemma, as they are highly accurate and can fly at low altitudes, behaving differently than ballistic warheads. A cruise warhead (*krylatyy boevoy blok*) consists of a "heat shield, within which is a cruise subblock (*krylatyy boevoy*

[33] Ibid., pp. 48-49.
[34] G. Vokin, "Remote-Controlled Cyber Weapons: Construction Principles and Functional Possibilities," *Armeyskiy Sbornik (Army Journal*), No. 8 2015, pp. 9-11.
[35] G. G. Vokin and M. I. Makarov, "Conceptual Foundations of the Creation of a New Class of Weapon—Remote Cybernetic Weapons," *Voennaya Mysl' (Military Thought*), No. 8 2020, pp. 117-125. The author would like to thank Dr. Harold Orenstein for the translation of this article.
[36] Ibid., pp. 118-119.

subblock)."[37] Depending on the composition of the latter, the functional purposes of the subblock may be:

- Reconnaissance-information (cameras, radar, target sensors, surveillance sensors, radio beacons, information transmitters)
- Strike (warheads of increased power with homing systems or increased fuel reserve for patrolling)
- Reconnaissance-sabotage (maps of dangerous areas, mines, coordinates for mines, mine-release devices)
- Additional reconnaissance (sensors for reconnaissance of targes, radio beacons, surveillance sensors)
- Reconnaissance-strikes (sensors for additional reconnaissance of targets, warheads, and mines)
- Rescue-support (munitions, weapons, medicines, food, rescue resources, etc.)[38]

RCW can be delivered to targets individually or a few at a time by a single carrier. The authors pointed out that there remain many problems to work out, such as the development of neurocomputer algorithms for target recognition; developing military-scientific scenarios for employing RCW and their expected combat effectiveness; and developing and designing variants of RCW means of destruction, among others.[39] In conclusion, it was stated that RCW "are an effective, non-nuclear means of warning, preemption, containment, and retaliation that our country needs now, and even more in the future."[40] Such weapons will make "an attack on our Motherland impossible."[41]

Navigation

Russia writes that practically every US weapon is hooked to satellite communications, GPS navigation, and the Internet, and REB operators claim to be able to shut these channels down with ease. Recent DARPA contracts, the Russian analysis noted, appear to focus on upgrading weak systems as DARPA is directing companies to design new systems able to function against electronic interference. Another Western concern is that Russia is not limited to just jamming NATO systems but can also intercept and manipulate US military targeting data. One US analyst, according to the same Russian publication, stated "If the enemy can get into command-and-control computers to provide wrong data, you could potentially call-in airstrikes against your own positions. If troops can no longer communicate, close air support becomes more time-consuming or impossible."[42]

There have been only a few publicized events of Russian attempts to block GPS signals. One of the most glaring, and perhaps a trial run at Russia's ability to destroy or block such signals,

[37] Ibid., p. 120.
[38] Ibid., p. 123.
[39] Ibid., p. 124.
[40] Ibid., p. 125.
[41] Ibid.
[42] Aleksandr Sitnikov, "US for the First Time 'Shuts Down' Russian Electronic Warfare in Syria. Account Published in America of New Method to Counter the 'Putin Threat,'" *Svobodnaya Pressa*, 18 October 2018.

was during the 2018 NATO exercise Trident Juncture. The Norwegian Defense Ministry blamed Russia for GPS malfunctions during the exercise and Finnish Prime Minister Juha Sipila stated that jamming from the Kola Peninsula had knocked out some of his nation's navigation systems.

Israel implied that the Krasukha-4 REB system was to blame for the recent inadequate performance of its Iron Dome air defense system. With an operating range of 300 kilometers, the Krasukha system could reach Israel if deployed in Syria. Zhitel, Divnomorye, or Borisoglebsk-2 systems may also be at fault, according to Israeli experts cited in the Russian report. None of these nations claim to have potential counters to these Russian systems.[43]

Early References to Reconnaissance-Strike and -Fire Operations, 1987 and 1996

In past wars, human reconnaissance "spotters" were used to find and report targets for artillery units. Soon new technologies were introduced, such as laser devices, that helped to precisely determine a target's coordinates. These devices were supplemented with navigation resources and other communication means. The military's Strelets system is one such development that combines all these assets. The result for Russia has been the quick development of RUK and ROK that can quickly fix and destroy targets of a strategic, operational, or tactical nature. Strike and fire measures include artillery, missiles, and aircraft that employ a noncontact (that is, other than between fighters on the ground) mode. Unmanned aerial vehicles (UAVs) and other reconnaissance assets (helicopters, etc.) have been introduced and are able to find and fix an opponent's precise location for destruction, since many are now armed as well.

Modern war's "victory triad," according to one discussion, includes reconnaissance, command and control, and fire engagement.[44] Command and control (C2) issues, electronic warfare, geoinformation systems, reconnaissance-information support, and weaponry must be tied together to form a unified system that shortens target detection and destruction. Engagement superiority goes to the side able to collect, process, and analyze information fastest.[45] Western audiences focus on different concepts, such as kill chains and other concepts that have similar but perhaps not identical ingredients. The military cultures and weaponry of the US and Russia are different, and this results in the use of different terminology and applications of weaponry.

The Russian topics of reconnaissance-fire and reconnaissance-strike forms and methods have acquired various and distinctive subsets. Just the number of associated abbreviations can be confusing. ROS, RUK, ROK, OROS, OKRUD, REOS, RPS, ROD, VROK, and ROO are abbreviations used either specifically or in relation to the reconnaissance-fire and -strike complexes. Each of the abbreviations (in the same order) is defined in Appendix One for reference purposes. As discussed above, there are also radio-electronic-strike operations, information-strike operations, and navigation under consideration.

In 1987, one of the first early references to ROK and RUK appeared in that year's edition of *Taktika (Tactics*), published under the authorship of General-Lieutenant V. G. Reznichenko, a

[43] Sergey Ishchenko, "Krasukha with Lysukha Have Struck Terror into NATO and Israel. A Norwegian Frigate on the Shoals, and the Iron Dome—Holes. Is this EW?" *Svobodnaya Pressa*, 13 November 2018.
[44] V. Kiselev, "Precision Engagements in Future War," *Armeyskiy Sbornik (Army Journal)*, No. 2 2017, p. 26.
[45] Ibid., pp. 31 and 27.

Russian professor at the Frunze Military Academy and an expert on the subject. The book noted that reconnaissance-strike (fire) (RUK [ROK], as written) complexes were the most effective form of high precision weapons. Reconnaissance and destruction could now be carried out practically in real time (the book noted that this was the view of foreign specialists). Such systems usually have four components: an automated reconnaissance and guidance system; a mobile ground control center; high precision weapons; and a system for the precise determination of the location of system components.[46] Reconnaissance-fire complexes (ROK) are usually positioned with division and brigade control posts.[47] However, it was unclear if the explanations offered were about the application of Russian terminology to advancements made in foreign nations or to Russia. What was clear was the use of RUK and ROK.

In 1996, the Chief of the Main Operations Directorate of the Russian General Staff at the time, Colonel General Viktor Mikhaylovich Barynkin, explained RUK and ROK. In the military journal *Armament, Politics, Conversion*, he discussed precision weapon effects on combat operations and military art. Most importantly, he discussed RUK and ROK operations, noting how new forms of combat operations and fire engagement using precision weaponry (VTO) would be needed. He stated that a transition to a multifunctional "reconnaissance-strike complex (RUK) (reconnaissance-fire delivery complex, ROK [as written])" would be required. When enough operational-strategic and operational-tactical RUKs and ROKs employing VTO become available, a massive fire strike concept for use in the initial period of war and before first operations must be developed.[48] No further distinction between RUK and ROK was offered.

Barynkin noted that a reconnaissance-fire delivery system (ROS) will include reconnaissance, fire engagement, and electronic warfare and will be supported by automated command and control. These assets are integrated "hierarchically, organizationally, technically, informationally, and functionally," which will become the basic form of integration. The ROS will allow for reconnaissance-strike-maneuver, fire and destroy, and other forms of fire engagement. The "fire and destroy" principle could lead to the gradual elimination of harassment, fire suppression, and even neutralization methods, since a one-time "critical mass of enemy losses" should be planned before friendly combined-arms groups are committed. Barynkin added that fire engagements may even acquire strategic significance, where war results are determined not by a quantitative but by a qualitative correlation of weapon systems during first operations. Area point engagements would be conducted by ROSs of each troop echelon in their zone of responsibility. Looking into the future, Barynkin stated that in the 21st century, "automated command and control systems using element of artificial intelligence" will do planning and fire control.[49]

The goal of ROS will be to crush the enemy with fire and weaken forces posed for combat. Strategic and operational-tactical means of long-range fire engagement will play the predominant role in determining an operations outcome, with tactical actions occurring as a secondary or concluding action. As a result, there may be a shift from successive methods of fire engagement

[46] V. G. Reznichenko, *Tactics*, Moscow Military Publishing House, 1987, p. 24.
[47] Ibid., p. 25.
[48] V. M. Barynkin, "The Effect of Precision Weapons on the Character of Combat Operations and the Development of Military Art," *VOORUZHENIYE, POLITICA, KONVERSIYA (ARMAMENTS, POLITICS, CONVERSION*), No. 3 1996, p. 19.
[49] Ibid., pp. 19-20.

to simultaneous and continuous engagement methods to the depth of an opponent.[50] With an increase in combat potential, a material basis will be created for the introduction of the reconnaissance-fire delivery operation (ROO), defined as follows:

> The aggregate of simultaneous and successive air, air defense and fire battles, engagements and strikes coordinated and interrelated in terms of goals, missions, place, and time and conducted jointly under a common concept and plan by groupings of reconnaissance, fire engagement, and EW personnel and assets on one or several strategic axes for purposes of crushing the enemy by fire.[51]

Barynkin concluded that operational massing will be achieved through "overwhelming fire-delivery and electronic preponderance" on decisive axes with VTO and other new weapons. This will be a one-two punch in future conflicts that will include the use of preemption and maneuver forms of warfare. The overriding goal in defensive operations will be to first crush the enemy by fire with VTO and then to conclude with forces and assets of troops. This means that fire-delivery and maneuver in the defense will lead to the exclusion of linear, positional forms of warfare, and to classic close combat.[52]

Reconnaissance-Strike Discussions: 2005, 2008, and 2009

In 2005, Colonel S. I. Matveyev discussed the transformation from the RUK/ROK organization to the RUS/ROS. Reconnaissance-fire systems (ROS), the author noted, will have high mobility and will be capable of attacking targets three to seven minutes after detection with a fifty percent destruction potential. In future operations, a combined-arms reconnaissance-fire system or OROS (*obshchevoyskovoy razvedyvatel'no-ognevoy sisteme*) will be developed. The delivery of fires will be simultaneous and not sequential, Matveyev stated, and planning and target engagement will be continuous,[53] which was in line with Barynkin's prediction in 1996.

In early 2008, due to the proposed use of the armed forces in a future war, new concepts and terminology were under development. The preemptive acquisition and possession of information through better intelligence devices helped planning and real-time control. For example, four military officers wrote about a concept known as the operating contours of reconnaissance-strike activities (*operativnyy kontur razvedyvatel'no-udarnykh deystviy)* or OKRUD. OKRUD is defined as

> The integrated totality of various reconnaissance, software, strike, and countermeasure forces and hardware that are covered by a common, uninterrupted, automated control in close-to-real time. Integration creates continuity between the processes of reconnaissance of important enemy facilities; the transmission, processing, and presentation of intelligence data; and the identification, target

[50] Ibid., p. 21.
[51] Ibid., p. 20.
[52] Ibid.
[53] S. Matveyev, "Precision Systems of the Missile Forces and Artillery: Perspectives and Basic Direction of Work for the Creation of Reconnaissance-Strike and Reconnaissance-Fire Complexes," *Voennaya Mysl' (Military Thought*), No. 2, 2005, pp. 22-23.

indication, precision, and autonomous homing of guided weapons to top-priority targets.[54]

In 2009, there was an explanation of how to categorize ROK, RUK, RUS, IUS, and other terms as specific spheres of military art in Russia (strategic, operational, tactical) in an article in the journal *Air and Space Defense*.[55] It noted the following designations of categories:

- The reconnaissance-weapon complex (range up to 30-40 kilometers, in the tactical zone) is a fast reaction, standalone, artillery complex where reconnaissance, weapons, automated fire control, and fire support complexes are integrated (for example, they are integrated with the unmanned aerial vehicle Pchela-1 and the Smerch multiple rocket launcher system).
- The reconnaissance-strike complex (RUK, range up to 200 kilometers, in the "operational zone") is an automated weapons complex designed for the timely detection and fire destruction of important enemy ground-based targets that use strike systems. An SU-27 with strike weapons and support equipment is such a complex.
- The reconnaissance-strike system (RUS, range up to 500 kilometers [sometimes greater], in the operational-strategic zone) is the aggregate of strike and support automated weapons and military equipment complexes.
- The information-strike system (IUS, range over 500 kilometers, in the strategic zone) is an automated weapon system designed for the highly effective destruction of one, several, or many facilities/targets using precision-guided strike weapons at great distances in accordance with the operations plan or its concept of operations.[56]

It is not known if or how these categories have changed under contemporary developments. However, in 2017 Russian General Staff Chief Valery Gerasimov noted that reconnaissance-strike loops include not only the Rocket Troops and Artillery but also Army Aviation and Su-24M bombers.[57] This implies that the RUK still maintains strategic missions.

Reconnaissance-Strike and Fire Discussions: 2015-2019

The journal *Armeyskiy Sbornik (Army Journal*) and other military journals published many works written by artillery and other branch officers. The following summary of a few of these articles is listed in accordance with their publication dates from 2015 through 2019.

[54] Ye. Gribov, V. Kazaryan, D. Karimov, and V. Khlopyak, "Using Precision Weapons in the Operating Contours of Reconnaissance-Strike Activities," *Vestnik Akademii Voennykh Nauk (Bulletin of the Academy of Military Science*), No. 3 (24), 2008, p. 46.
[55] Igor Morozov, Sergey Baushev, and Oleg Kaminskiy, "Space and the Character of Modern Military Activities," *Vozdushno-kosmicheskaya i Oborona (Air and Space Defense*), No. 4, 2009, pp. 48-56, downloaded from the Eastview web site.
[56] Ibid..
[57] Sergey Obukhov, "EMD Rocket Troops and Artillery Training Intensively to Function as Reconnaissance-Fire/Strike Circuits," *Krasnaya Zvezda (Red Star*), 17 November 2017.

In 2015, V. Litvinenko wrote on the integration of reconnaissance, control, and destruction systems under 21st century conditions, which reflected a change from platform-centric warfare to network-centric warfare. The main idea of the latter is "the comprehensive integration of weapons systems and resources within the framework of a unified system of command and control (C2) of troops."[58] Information technologies allow combat systems to interact better and reduce the C2 time cycle. Information and networks working together help achieve information superiority over an opponent through their collection, processing, modeling, decision-making support, and data transmission capabilities nearly in real time. The network-centric model consists of sensors, information, and combat, where reconnaissance and destruction means are united by C2. When "creating such a C2 system, fire destruction resources are essentially a global reconnaissance-strike complex (RUK). Precision-weapons and those based on new physical principles destroy, disorient, and **disorganize** enemy systems."[59]

The network-centric principle of C2 changes how reconnaissance is conducted, creates a single information field in the battlespace, and simplifies planning and coordinating fire damage and other types of effects, which help ensure reconnaissance-fire systems function well during armed confrontations.[60] The US Armed Forces "Shock and Awe" operations used in Iraq were deemed to be an integrated single spatially distributed reconnaissance-destruction system (*razvedyvatel'no-porazhaiushchaia sistema or RPS*). Litvinenko stated that information-control systems in a single information domain changed the nature of military conflicts.[61] There are still, however, several shortcomings to overcome. The main problems for systems developing reconnaissance and information transmission destruction means are the lack of interaction with other analogous systems, their inability to receive and transmit information in real time, the failure of software to transmit data, and other technical facts.[62]

Finally, Litvinenko recommended that Russia borrow some Chinese concepts, especially the use of asymmetric effects against an opponent, namely "fire and electronic damage of the elements of the information grid (command posts, communications centers, orbital grouping of reconnaissance and control satellites, etc.)."[63]

In a February 2017 article in *Armeyskiy Sbornik (Army Journal*), Litvinenko and co-author S. Voronkov discussed artillery fire and maneuver. They wrote that fire and maneuver were the new approaches to fire engagement, with the most important roles belonging to battalion and brigade artillery subunits. Artillery must be capable of the following missions:

- Conducting highly maneuverable operations

[58] V. Litvinenko, "The Comprehensive Integration of Reconnaissance, Control, and Destruction Systems under Conditions of 21st Century Military Concepts," *Armeyskiy Sbornik (Army Journal*), No. 8 2015, p. 33. The author would like to thank Dr. Harold Orenstein for the translation of this article.
[59] Ibid., pp. 33-34.
[60] Ibid., p. 36.
[61] Ibid., p. 35.
[62] Ibid., p. 36.
[63] Ibid.

- Delivering fire for effect to the full depth of an opponent's battle formation
- Engaging the enemy with direct and indirect fire
- Destroying enemy tactical precision-guided munitions
- Suppressing and destroying command and control and fire control posts, radars, EW, and air defense assets
- Conducting engagements of enemy personnel and weapons during preparation for attacks, battles in the depth of enemy defense, repelling counterattacks, and conducting defensive operations
- Conducting counterbattery fire
- Destroying enemy antitank weapons and other armored vehicles
- Conducting battle against reserves and irregular elements
- Dispersing formations while preserving fires massed in time and space.[64]

The authors added that "For future fire engagements of the enemy, weapons can be integrated in a unified reconnaissance-fire system (ROS), which implements a zonal-installation principle of organizing reconnaissance and engaging the enemy."[65] A diagram (see Appendix Two for the diagram and key) of the ROS followed this description, with the subtitle as follows: "Functional ties among elements in a tactical (battalion) module of a first-order missile troops and artillery reconnaissance-fire system."[66] This would strengthen the argument that ROS is a tactical system. Artillery recommended for the combined-arms brigade included two self-propelled artillery battalions of 152-mm howitzers and a rocket artillery battalion of 122-mm multiple-launch rocket systems, as well as a 120-mm artillery battery for each motorized rifle battalion. These components should guarantee the capability to conduct maneuverable reconnaissance-fire combat operations.[67] Long-range fire destruction, to include rocket forces, artillery, and aviation, is determining combat potential.

In March 2017, authors Savapin, Tikhanychev, and Chernov recommended to develop a cross-service strike and fire-capable reconnaissance system (CSSFCRS) to raise the efficiency of the fire destruction of an opponent. The concept was described as a prototype in 2017, one that can offer an integrated combat environment. The CSSFCRS concept will make it possible to increase the fire destruction of an adversary more efficiently through the implementation of actions that forestall an adversary's plans and thereby help maintain friendly force initiatives. There are hurdles to cross, naturally, such as the systems requirements for specialized mathematical and information-linguistic support along with a need for a suite of special software. Some of the important demands on CSSFCRS components will be the need to adapt reconnaissance, control, and fire component integration and to aim at solving the tasks of fire destruction. These demands must be supplemented with the installation of security measures in both the physical sphere against

[64] V. Litvinenko and S. Voronkov, "Artillery Fire and Maneuver: The Role of Artillery of a New Type for Tactical Force Elements in Armed Conflicts of the Late 20th and Early 21st Centuries," *Armeyskiy Sbornik (Army Journal*), No. 2 2017, p. 35.
[65] Ibid., pp. 35-36.
[66] Ibid., p. 35.
[67] Ibid., p. 38.

adversary reconnaissance and strike assets and in the information environment, among other demands.[68]

In an interesting interview **in April 2017**, Missile and Artillery Chief Lieutenant General Mikhail Matveyevsky offered his thoughts on the emerging forms and methods of the tactical employment of artillery. Forms, he noted, remain operations, battles, systematic combat operations, strikes, and maneuvers. These will remain so until 2030. Methods are the procedures for employing force and equipment to achieve a form or war's goals. This may require an organizational realignment of specific structures to ensure a rapid response to various contingencies. Maneuver will remain a focus of improvement as will achievements in intelligence and information superiority over an opponent.[69]

Matveyevsky noted that improvements were needed in the speed of response and accuracy of RUKs of all services, and in the level of integration and speed of weapon, reconnaissance, command and control, and support systems that create ROKs efficiency and accuracy. There will be a focus on improving maneuver and fire operations as well. To boost the ability to conduct maneuver strikes and fires, it "is envisaged to increase the size of firing and starting position areas." Operating autonomously at large intervals, combat groups, each possessing one self-propelled artillery gun and ammunition delivery transport, are envisaged along with the following maneuver and fire cycle: artillery attack—maneuver—preparing the self-propelled artillery gun for the next attack—loading the ammunition compartment. Autonomous groups carry out missions in tactical zones of action along prepared maneuver routes with ammunition resupply locations and seven to eight prepared firing positions. This should reduce losses of artillery by 23-37 percent. In offensive operations artillery can conduct fire for effect with attacks of 6-10 rounds per minute in a short duration span of 1-4 minutes.[70]

Matveyevsky listed several modern principles of artillery use. These included the following:

- The principle of a rational combination of the dispersed employment of maneuver-and-fire operations by RViA, to help achieve operational and tactical effects of fires impact on an opponent
- The principle of the asymmetric pre-emption of the enemy while conducting systematic fire, and the destruction of critical assets using mainly high-precision weapons, which require a response time faster than an opponent's

[68] O. V. Sayapin, O. V. Tikhanychev, and N. A. Chernov, "The Creation of an Interservice Reconnaissance-Destruction System as a Base for Increasing the Effectiveness of Fire Efficiency," *Voennaya Mysl' (Military Thought*), No. 3 2017, pp. 32, 36-37.
[69] Mikhail Matveyevsky, "The Missile Troops and Artillery: The Development of Forms and Methods of Combat Employment," *Armeysky Sbornik (Army Journal*), No. 4 2017, pp. 21-22.
[70] Ibid., pp. 23-24..

- The principle of the resource-oriented distribution of RViA's efforts, which involves the distribution of assets based on reach, resource intensity, and size of the resource allocated in the joint use of the enemy's fire forces.[71]

Modes of "fire for effect" include structural, asset-oriented, barrier, and fire blocking, that is the spatial-temporal sequence for destroying the enemy's task forces, combat and support systems, and critical assets.[72] Fire for effect against combat and support systems should be simultaneous and based on penetrating an opponent's task force (locations, etc.) with ROS. Artillery assets on the move will be dispersed with weapons in a stand-by mode. When a target is detected it will be destroyed with a short fire attack followed by a quick maneuver out of the area and the occupation of a new firing position.[73]

Also in April 2017, in an article in *Armeyskiy Sbornik (Army Journal*), V. Litvinenko and co-author S. Tolochko noted that the contemporary state of military art's development has become characterized by a "substantial increase in the role and place of fire destruction of the enemy."[74] A new generation of conventional weapons indicates that arithmetical superiority (the quantitative correlation of forces) no longer creates "decisive prerequisites for defeating an enemy," since the qualitative component now dominates the quantitative component. There has been a shift from the targeted destruction of an area to the destruction of a specific target.[75] The planning and implementation of fire destruction will most likely be a zonal-targeting method, and the main form of employing forces will be according to a maneuver-fire design. One of the new forms of fire destruction is reconnaissance-fire methods and operations. The reconnaissance-fire method of operations for artillery formations is defined as follows:

> Operations of forces and means of reconnaissance, automated command and control, and fire destruction, coordinated with respect to targets, tasks, place, and time, for effects against the most important and high-mobility enemy targets, including direct laying fire. These operations are to be implemented in real time, according to the principle of 'reconnaissance-hit…'[76]

These capabilities will enable forces to strike where and when they need to create effects.

A short statement about fire destruction ended the article, but it was significant. The authors noted that "The need to create artillery groupings (army artillery groups, division artillery groups,

[71] Ibid., p. 26.
[72] Ibid., p. 27.
[73] Ibid., pp. 28-29.
[74] S. Tolochko and V. Litvinenko, "Forms and Methods of the Selective Destruction of the Enemy," *Armeyskiy Sbornik (Army Journal*), No. 4 2017, pp. 32-33. The author would like to thank Dr. Harold Orenstein for the translation of this article.
[75] Ibid., p. 33.
[76] Ibid., p. 35.

brigade artillery groups, etc.) will disappear, because the reconnaissance-fire resource itself envisions the effective selection for the means of destruction."[77]

Litvinenko and a different co-author, this time S. Yastrebov, defined a reconnaissance-fire system (ROS) in **August 2017** as follows:

> The reconnaissance-fire system (ROS) is an organizationally, technically, informationally, and functionally integrated aggregate of fire engagement forces and assets and of operational, combat, and technical support joined by unified, automated command and control and supporting the discovery and engagement of enemy groupings and targets to the full depth of his operational alignment.[78]

Other authors utilized a nearly identical replication of this definition, so it appears widespread and well accepted.

The objective of precision-guided munitions (PGM), the authors note, is the selective destruction of key (critically important) targets [indicating to U.S. planners that key targets need to be defended or decentralized so that one node's destruction does not destroy one's overall capability], which lower an opponent's combat potential and **disorganizes** the command and control of combat operations.[79] Missile, rocket artillery, and artillery subunits of the ROS are "**used in the form of reconnaissance-strike (fire) loops**" to reduce the acquisition, engagement, and destruction time of targets. PGM's integration into ROS result in new forms of combat employment and new methods of executing fire missions, with the reconnaissance-fire method still the primary one:

> It should be expected that massive and concentrated fire strikes will be the main forms of fire pressure on the enemy with the employment of PGMs, and that systematic fire actions will take the form of the targeted execution of fire missions by highly organized complexes (mobile combat platforms) during the execution of specific tactical missions by combined-arms force elements of the new type.[80]

It is unclear if the word "massive" envisions firing many weapons at one target or just firing at a lot of specific targets using fewer weapons due to PGMs.

The focus will be reconnaissance-fire actions and the radio-electronic suppression of enemy targets presenting the greatest threat to brigade activities.[81] Surprise is developed from using PGMs when opponents are first detected. Fire missions include maneuver-fire arrangements

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[77] Ibid., p. 36.
[78] V. Litvinenko and S. Yastrebov, "Precision-Guided Munitions: A Look at the Future: Directions for the Development of State-of-the-Art Precision-Guided Munitions," *Armeyskiy Sbornik (Army Journal*), No. 8 2027, p. 15.
[79] Ibid., p. 12.
[80] Ibid., p. 14.
[81] Ibid.

in the following order: deployment to firing positions; on acquiring targets, immediate engagement with a salvo lasting no more than 1-3 minutes; safe exit from a zone of retaliation (1-1.5 minutes); and occupation of a new firing position for the next fire mission (1-2 minutes).[82] First, the robotization of missile troops and artillery will increase survivability. Second, PGM improvements will result in the "intellectualization" of weapons, offering the ability to identify a target and choose its most vulnerable spot. This "highly-intelligent" phase of PGM development includes lasers, beams, radio-frequency weapons, and other weapon types.[83]

In October 2017, this time in conjunction with a co-author, Mayveyevsky and M. A. Safronov discussed the need to develop more precise, real time reconnaissance activities to better support ROS. They are needed to inflict damage against both relatively immobile and highly maneuverable opponents. Naturally, there is more lag time allowed between acquisition and destruction for the former and less for the latter. The main enemy targets to be hit include the following: operational-tactical missile launch pads at their start positions (even if on the march); artillery batteries, multiple rocket launcher systems, mortar platoons at firing positions; AN/TPQ-36 and AN-TPQ-37 radar stations [strange that these two systems would be singled out]; artillery division fire control enters; and artillery battery fire control posts.[84] It is unknown if the reference extends to the TPQ-50 and TPQ-53.

In 2018, Litvinenko stated that noncontact or reconnaissance-fire forms were playing a greater role in operations. To effectively use artillery's fire and maneuver capabilities provisional reconnaissance-fire complexes (VROK) were established. The latter was defined as follows:

> The provisional reconnaissance-fire complex, abbreviated VROK, should be understood to mean an integrated system of forces and assets of reconnaissance, weapons, and automated command and control and support equipment dynamically formed in planning and organizing coordination and used in the subsequent course of combat operations.[85]

He noted that preemption in fire engagements determines modern battles, based on artillery experiences in the Syrian Arab Republic. Combat productivity of the VROK will depend on variables that can be depicted by the following mathematical relationship:

> W= (Tp; At; Moz), where W is the overall time cycle of the rate of fire; Tp is the time cycle for reconnaissance assets to acquire and transmit information; At is response time of automated C2 equipment, including decision-making, will be

[82] Ibid., p. 16.
[83] Ibid., p. 17.
[84] M. M. Matveyevsky and M. A. Safronov, "The Organization and Conduct of Reconnaissance in the Interest of the Combat Use of Missile Forces and Artillery in Present Day Operations," *Voennaya Mysl' (Military Thought*), No. 10 2017, pp. 7-8.
[85] V. Litvinenko, "Organization of Coordination: Provisional Reconnaissance-Fire Complex (VROK), Mission, Composition, Combat Capabilities," *Armeyskiy Sbornik (Army Journal*), No. 8 2018, pp. 23-24.

constant in performing one's functional tasks; and Moz is the **time cycle** for receiving the fire mission and its execution.[86]

Without a clearer explanation of the equation, it can only be assumed that W is just a function of the three variables.

A reconnaissance-fire action/operation (*razvedyvatel'no-ognevye deistviya)*, or ROD was defined as the simplest form of the systematic delivery of fire or (*sistematecheskoe-ognevye vozdeistviya*) (SOV). The SOV is conducted by specially assigned fire means of a combined-arms formation (subunit) for engaging (disrupting the functioning of) newly detected important enemy targets in the zone (area) of responsibility of a combined-arms formation (subunit). The essence of ROD is the joint employment of reconnaissance assets (subunits) and destruction means in the form of a unified, continuous process aimed at engaging enemy targets with requisite effectiveness in a minimum of time, which is the essence of reconnaissance-fire actions/operations.

VROK's structure depends on the type of target to be engaged, the level of reconnaissance assets employed, and the level of C2 assets used. Mission execution can be influenced by, first, the time of preparing and laying an artillery grouping, the range of fire, and the power of the munitions employed. Second, the accuracy in determining coordinates and time of target acquisition. Third, the range of communications, their stability, security, jam resistance, and data processing time. And finally, the volume and rate of supply movement. To evaluate the effect of the VROK, two principal items are used: the kill probability (degree of damage) of the target that took place in the required time; and the number of targets engaged that took place without consideration of ammunition replenishment. Other parameters (meteorological, ballistic, topo-geodetic support, UAVs, radar complexes, fire control complexes, etc.) can also affect outcomes and precision.[87]

Litvinenko then expressed "in seconds" the amount of time it takes to launch a mission and **where gaps might** develop. In the latter case the following were offered:

- Generation of the report by the chief of the formation's artillery and its transmission to the missile battalion commander (20-30-40 seconds)
- Work of the missile battalion command in organizing coordination with reconnaissance assets (17-22-28 seconds)
- Process of laying and loading (30-40-60 seconds)[88]

Experiences in Syria demonstrated that employing one Smerch MLRS fighting vehicle along with an Orlan UAV permitted the fastest-response mode. For that reason, the most promising

[86] Ibid., p 24.
[87] Ibid., p. 24.
[88] Ibid., p. 26.

reconnaissance assets for integration with a missile battalion were the following, most likely indicating the response speed or time from detection to fire:

- SNAR-10 (102-151-205 seconds)
- Orlan UAV (87-128-190 seconds, against enemy columns and other target types, thus the most promising).[89]

The term "VROK zone of reconnaissance and engagement" will be used for fire engagement responsibility. Zones could be a "formation zone of reconnaissance and engagement (2S19 Msta-S 152-mm, Grad 122-mm)," a "battalion zone of reconnaissance and engagement (120-mm mortar, Vena 120-mm or Khosta 120-mm self-propelled gun)," or an "operational command zone of reconnaissance and engagement (Uragan Reap [rocket artillery regiment], Smerch Redn [rocket artillery battalion])." Frontage, depth, and productivity (targets to hit) capabilities were included in a table. Automated control systems in the VROK were said to increase effectiveness by 20-30 percent.[90] It was noted that the staff must determine the objectives of the operation, that VROK missions are determined in the operation order, and that the VROK commander organizes coordination among commanders in terms of time, missions, and methods.[91]

In March 2019 Russian General Staff Chief Valery Gerasimov noted in a speech at the Academy of Military Science that the West's policies have forced Russia to "answer a threat with a threat," that being a Russian plan for strikes against Western decision-making centers and launchers of cruise missiles aimed at objectives on Russian territory. This also requires the development of a unified system of integrated intelligence, destruction, and command and control forces and means based on contemporary information and telecommunications technologies. This system includes strategic and operational-tactical nonnuclear weapons.[92] So, Gerasimov envisions strikes, not fires, against Western systems.

In April 2019, the maneuver and fire option for the use of artillery was restated in relation to lessons learned during fighting in Syria. At a training range near Chelyabinsk, in the Southern Urals, the "artillery carousel" was under test conditions as a new method for using artillery within a reconnaissance-loop (contour). After a fire mission is executed, the crew withdraws to a specially prepared reloading region, after which "they continue to fire, but now from a new, prepared position."[93] Colonel-General Aleksandr Lapin, commander of the Central Military District at the time, noted that the creation of a ROK permits follow-up reconnaissance and fire damage

[89] Ibid.
[90] Ibid., pp. 26-27.
[91] Ibid., p. 27.
[92] V. V. Gerasimov, "The Development of Military Strategy under Contemporary Conditions. Tasks for Military Science," *Vestnik Akademii voennykh nauk (Journal of the Academy of Military Science)*, No. 2 2019, pp. 6-11. The author would like to thank Dr. Harold Orenstein for the translation of this article.
[93] No author provided, "New Method of Using Artillery Tested at Central Military District Range Near Chelyabinsk," *Ministry of Defense of the Russian Federation*, 11 April 2019.

assessment after each mission and allows the next fire mission to be from different firing positions and over a short period of time.[94]

In December 2019, Litvinenko and Yastrebov wrote an article titled "Our Answer to Multi-Sphere Operations," the latter being the Russian language version, apparently, of multi-domain operations. They wrote that when defending against a strong, technically equipped enemy capable of highly maneuver operations, systematic fire effects will be chosen as the "principal form of fire effects," while planned fire strikes will be made against infrastructure targets supporting maneuver operations and "the operations of cyberspace structures." Reconnaissance-fire operations along with radio-electronic warfare resources are the basic forms of tactical operations against such enemy forces.[95]

The reconnaissance-fire module will include conventional and rocket artillery subunits, radar artillery, radio-engineering artillery, instrumental intelligence artillery, and a UAV detachment. It was then stated that "the decisive place will most likely be given to reconnaissance-fire complexes, which have demonstrated high quality during the struggle against terrorists in Syria."[96] The authors added that due to the US's new tactics, Russian theorists will need to reexamine operational art and tactics individual tenets and the quality of equipment and weapons "for intelligence resources, automated command and control, and fire and strike means of destruction."[97]

The authors then changed from discussing complexes to systems. For a reconnaissance-fire system, the need was stated:

- To create a complex of existing resources for intelligence, destruction, and all-round support based on developing automated means of command and control, which will make it possible to create a technical foundation for RViA reconnaissance-fire systems
- To modernize the most effective existing models (complexes) of weapons and military equipment, which will make it possible to maintain and improve their fire (combat) capabilities
- To create precision and high-mobility models (complexes) of weapons with means of individual (group) protection against the enemy's precision weapons, which will make it possible to effectively destroy enemy targets to the entire depth of his operational structure.[98]

Munitions will be improved with the addition of artificial intelligence that increase their power and capabilities for detecting targets.[99]

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[94] Ibid.
[95] V. Litvinenko and S. Yastrebov, "Our Answer to Multi-Sphere Operations," *Armeyskiy Sbornik (Army Journal)*, No. 12 2019, p. 38. The author would like to thank Dr. Harold Orenstein for the translation of this article.
[96] Ibid., p. 39.
[97] Ibid.
[98] Ibid., p. 40.
[99] Ibid., p. 41.

A study of the U.S.'s "multi-sphere battle" (which appears to be a reference to the U.S. multi-domain operation concept) focus, according to the authors, offer the following trends for Russian artillery specialists who are focused on developing the theory and practice of employing artillery in battle:

- Further assimilation of the new concept of enemy fire destruction in an operation (battle)
- Theoretical development and validation of the basic tents of a reconnaissance-fire operation (battle)
- Development of the basic tenets and practice of the employment of RViA in a reconnaissance-fire battle
- Introduction of a combined arms methodology for planning fire and nuclear destruction of an enemy and a methodology for planning the fire and nuclear destruction of an enemy by RViA staffs
- Development of new principles of the combat employment of RViA (principle of "active artillery")
- Adoption of new guiding documents on the combat employment of branches of forces in an operation (battle).[100]

In summation, the authors noted that it is necessary to integrate all forces and means, to include C2, communications, navigation, and intelligence systems into a single information space. There must be a simultaneous synchronization of these operations. The operations of brigades must be of an adaptive nature to ensure they can react to sudden changes in the situation. Finally, decentralized operations of all types of brigades based on a single plan must be realized along with the achievement of intelligence and information superiority over an opponent so that timely command decisions can be made.[101]

Conclusions

The 7 November 2020 issue of *The Economist* noted the following about Russian President Vladimir Putin's new army:

> Russia's ultimate aim is to create a 'reconnaissance-strike complex'—originally a Soviet idea—in which data from vehicles on the ground, drones in the air, satellites in space, and radio signals emitted by enemy units are collected, processed, and fed into the weapons in real time. Any 'sensor' (for instance, a 'drone') can feed a target to any 'shooter' (like a faraway ship), with targets prioritized centrally and struck, ideally, within minutes.[102]

Russia's development of tactical, operational, and strategic strike and fire complexes are widespread. The nation's military has assembled a series of strike and fire forms that include RUK, ROK, IUO, REU, and REOU. RUK and ROK utilize UAVs and Strelets systems, among other

[100] Ibid.
[101] Ibid.
[102] No author provided, "Putin's New Model Army," *The Economist*, 7 November 2020, p. 45.

measures, to spot targets and deliver precise targeting. IUO utilizes information channels to penetrate systems and conduct strikes, and REU/REOU utilize frequency intercepts to conduct the business of disorganizing opponents. At times complexes are involved, at other times systems or loops/circuits (in Russian, contours).

New to many Western analysts in this discussion of reconnaissance-strike and -fire issues were the additions of the information, electronic, and navigation aspects of strike and fire missions. Some are aimed at destroying or damaging equipment or facilities while others aim to disorganize communications or command and control links. Ryabchuk, in the opening quote to this paper, also mentioned intellectual strikes. Thus, there are other strike and fire issues about which the West should be concerned and on the lookout. The important aspects of such missions were summed up in the VROK discussion:

> VROK's structure depends on the type of target to be engaged, the level of reconnaissance assets employed, and the level of C2 assets used. Mission execution can be influenced by, first, the time of preparing and laying an artillery grouping, the range of fire, and the power of the munitions employed. Second, the accuracy in determining coordinates and time of target acquisition. Third, the range of communications, their stability, security, jam resistance, and data processing time. And finally, the volume and rate of supply movement.
>
> To evaluate the effect of the VROK, two principal items are used: the kill probability (degree of damage) of the target that took place in the required time; and the number of targets engaged that took place without consideration of ammunition replenishment. Other parameters (meteorological, ballistic, topo-geodetic support, UAVs, radar complexes, fire control complexes, etc.) can also affect outcomes and precision.[103]

Russia was prompted, some Russian authors note, to develop these strike and fire forms due to the U.S.'s Prompt Global Strike (PGS) system, which one article noted could become a possible orbital reconnaissance-strike system, employing advanced warheads for a number of systems.[104] To answer such a U.S. capability Russia has invested heavily in a number of high-tech developments. One, according to *The Economist*, is a nuclear-powered cruise missile that can circle the earth indefinitely.[105] Such developments appear to follow the advice of General Staff Chief Gerasimov, who noted it was time to "answer a threat with a threat."

[103] Ibid., p. 24.
[104] Ilya Kramnik, "The Army: Promptly and Globally. Will the United States Be Able to Depreciate Russia's Nuclear Arsenal?" *Izvestiya Online*, 13 October 2017.
[105] "Putin's New Model Army," p. 46.

The Russian systems to confront PGS and other Western strike capabilities were described above. They have been tested in major exercises, such as Zapad-2017.[106] UAV and other reconnaissance vehicles are under development, to include the following:

> The Russian military department has developed a special computer program that will teach unmanned air vehicles to independently identify targets on the battlefield in any condition, during the day, at night, in bad weather, and even when the adversary is jamming and creating decoy targets.[107]

Other Russian equipment also can conduct strike and fire actions, such as the reconnaissance-strike Ka-52 Alligator helicopter[108] or mobile reconnaissance-strike robot complexes. Vikhr combat robots, for example, can be installed not just on ground vehicles but also on Su-25 ground-attack aircraft.[109] Another report noted that, before 2030, Russia hopes to have a reconnaissance-strike capable hypersonic aircraft,[110] and plans are underway to construct space systems that can neutralize Western systems in that domain. Work is being done on an inter-service automated RUS, which reportedly can increase the accuracy for target strikes.[111]

Thus, a series of developments are underway in Russia on strike and fire means. It is very important for Western audiences to take note of these changes and how Russia intends to use them, whether it be as a preemptive (take out Western kill chains) or defensive weapon. Now is the time to consider not only how Russia might employ them but also how to counter them.

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[106] No author provided, "The Zapad-2017 Exercise Will Demonstrate the Integrated Employment of Automated Troop Command and Control Systems and Reconnaissance-Strike (-Weapon) Loops," *Ministry of Defense of the Russian Federation,* 15 September 2017.
[107] Aleksandr Ramm and Vasilisa Belokopytova, "Defense Ministry to Teach Drones to Accurately Identify Targets," *Izvestiya Online*, 22 March 2017.
[108] Anton Valagin, "Russia Has Doubled 'Alligator' Production," *Rossiyskaya Gazeta Online*, 5 June 2017.
[109] Ruslan Melnikov, "Video Has Appeared Showing Tests of the Heaviest Russian Combat Robot," *Rossiyskaya Gazeta Online*, 23 April 2017.
[110] V. V. Selivanov and Yu. D. Ilyin, "On Selecting Priorities in the Development of Kinetic Weapons for Solving Tasks in Military Conflicts," *Voennaya Mysl' (Military Thought*), No. 7 2017, pp. 29-40.
[111] *Interfax,* 24 March 2018.

APPENDIX ONE: DEFINITIONS

The following definitions are listed in order according to these abbreviations: RUG, ROS, RFS, RUK/ ROK, RUK, REOS, RPS, ROD, VROK, ROO, "kontur," and RLA.

Reconnaissance-strike group [*razvedyvatel'no-udarnaia gruppa*/RUG]: in the Air force – the main element of the combat formation of an aviation subunit (unit), intended for reconnaissance of enemy targets and their destruction. The appearance of RUGs is associated with the development of the theory of air reconnaissance-strike operations that assume the use of air reconnaissance forces and means with strike forces and means in a single complex (system). The RUG can consist of aircraft of the same type (helicopters) that have reconnaissance-strike (search and strike) properties, whose crews carry out the search, detection, and employment of means of destruction against enemy targets they have discovered in real time. In a different variant, the RUG can consist of different aircraft that have only reconnaissance and only strike properties. Some crews carry out the search, detection, and determination of coordinates of enemy targets, and transmit target designation (guidance), while other crews employ means of destruction, using the information from the scouts. The RUG can be employed to hit both enemy land (maritime) and air targets. Similar RUGs have been created in naval aviation.[112]

Reconnaissance-fire system (ROS) (*разведывательно-огневая система* (РОС)) – hierarchically, organizationally, technically, informationally, and functionally integrated totality of forces and means of fire and other types of destruction, supporting the disclosure of enemy groupings and targets and their effective destruction in real time.[113]

Reconnaissance-fire system (ROS) (*разведывательно-огневая система* (РОС)) – a system of the missile troops and artillery (RViA) of a large formation into which enter the recce-strike and recce-fire complexes of large formations, formations, and units having a single automated command and control system.[114]

Reconnaissance-strike (reconnaissance-fire) complex (RUK [ROK]) (*разведывательно-ударный [разведывательный-огневой] комплекс*) (РУК [РОК]) – a formation of rocket (artillery) units (subunits) that organizationally, technically, and functionally links reconnaissance, guidance, command and control, and fire destruction resources into a circuit capable of carrying out detection, target indication, guidance, and reliable destruction of enemy targets with a high

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[112] *Military Encyclopedia*, Moscow Military Publishing House, 2003, Volume 7, p. 145.

[113] V. L. Komol'tsev and P. I. Mikheev, "On Ensuring Information Compatibility When Creating Automated Command and Control of the RViA," *Voennaya Mysl' (Military Thought*), No. 6 2004, pp. 19-22. [Found on page 541 of Vol 2, terminology book]. The author would like to thank Dr. Harold Orenstein for his translation of this definition.

[114] S. I. Matveev, "High-Precision Systems of RViA: Perspectives and the Basic Direction of Work in the Creation of Reconnaissance-Strike and Reconnaissance-Fire Complexes," *Voennaya Mysl' (Military Thought*), No. 2 2005, pp. 22-27. [Found on page 545 of Vol 2, terminology book]. The author would like to thank Dr. Harold Orenstein for his translation of this definition.

degree of precision in an automated regime and in the shortest time. Each RUK (ROK) should include subsystems that ensure its autonomous functioning: reconnaissance and guidance, controlled means of destruction, navigational and time support, command and control, and special technical and rear area support.

The principal structure of the interaction among these subsystems in the process of the combat employment of RUKs (ROKs) is as follows: Reconnaissance resources search, detect, identify, and measure the necessary parameters of the targets in the complex's zone of control. Information about the detected targets is transmitted in an automated regime to the center for collecting and processing information and controlling the complex. At the center it is analyzed and compared with information from other sources. A decision is made about destruction, after which information necessary for its organization is transmitted to resources for fire effects, target accompaniment, and weapons guidance. On command from then center for control of the complex, precision fire effects resources deliver strikes against the indicated targets. Munitions guidance is implemented at remote distances from the targets with the help of the reconnaissance subsystem's resources for target accompaniment and weapons guidance as the target is approached – with the help of self-guiding warheads set up on the munitions.

Taking into account the importance of the fire destruction tasks being carried out, the complexes, with respect to their qualitative parameters, should be mobile, highly maneuverable, and fast-acting RViA structures, employing precision munitions, and have the ability to deliver strikes (raids) against newly reconnoitered targets no more than 3-7 minutes from the time they are detected, destroying these targets with a probability of no less than 50%. The delivery of short fire strikes (fire raids), with a duration of no more than one minute, will make it possible to leave the initial (fire) position in 2-4 minutes, thereby getting out from under enemy strikes and maintaining survivability.[115]

Reconnaissance-fire complex [*razvedyvatel'no-ognevoi kompleks*/ROK] – a rapidly-acting autonomous artillery complex, which is assumed to combine means of artillery reconnaissance, destruction (based on precision munitions), automated control of fire, and fire support. The term was first introduced to designate formations in which means of reconnaissance and destruction were integrated for the purpose of executing fire tasks in real time. Subsequently, variants were developed in which only self-propelled gun and multiple rocket launchers with precision munitions with different principles of guidance were the means of destruction. However, in connection with the narrowly specialized designation, which made it possible to resolve only a limited number of fire tasks (destruction of tank columns, firing guns, and radio-emitting resources), the practical implementation of ROKs was not obtained. As highly effective fire resources and supporting resources improved, a shift to a general, multilevel (from battalion to front) reconnaissance-fire system for the rocket forces and artillery of the Ground Forces was possible.[116]

[115] Ibid.
[116] *Military Encyclopedia*, Moscow Military Publishing House, 2003, Volume 7, p. 145.

Reconnaissance-strike complex [*razvedyvatel'no-udarnyi kompleks*/RUK, 2003 definition**]** – an automated weapons complex intended for the timely detection and highly-effective fire destruction of the most important enemy land (water surface) targets by strike resources (rocket, aviation) quickly, as they are found. The following tasks can be assigned to RUKs:

- destruction of resources for delivering tactical and operational-tactical nuclear weapons
- destruction of a first echelon attacking or defending enemy
- interdiction and destruction of second-echelon reserves (in the defense – for the purpose of thwarting the enemy's build-up efforts; in the offense – for the purpose of thwarting enemy counterattacks and counterstrikes)
- struggle against groups of surface ships
- disruption of command and control of troops, aviation, and means of destruction by incapacitating command posts
- destruction of radio-electronic warfare resources
- isolation of areas of combat operations by striking and incapacitating airfields, railroad transport centers, ports, bridges, crossings, and other infrastructure in a theater of military operations.

RUKs are subdivided into operational-strategic, operational, operational-tactical, and tactical with respect to their organizational structure and the nature of the tasks they are carrying out and they operate in areas of responsibility of the corresponding combined arms formations. RUKs consist of means of reconnaissance and guidance; automated command and control; destruction (precision weapons); radio-electronic suppression; navigation and timing support; special technical and rear support.

RUKs are created in practically all states that have precision weapons and effective reconnaissance resources. In the USSR, for example, in the mid-1950s RUKs were created to destroy groupings of surface ships, in which were combined the information technology communications of submarines with long-range anti-submarine missiles and the reconnaissance aircraft with a radar detection and targeting system. The complex successfully resolves the task of transmitting radar images of the search area from the reconnaissance aircraft to submarines and coastal command posts in real time. Subsequent generations of this type of RUK made the information technology coupling of carriers of means of destruction (submarines and surface ships) with a system of maritime and space reconnaissance and targeting, which continuously conducts reconnaissance of the situation on the water surface in the World's Oceans.[117]

Operating contours of reconnaissance-strike activities (*operativnyy kontur razvedyvatel'no-udarnykh deystviy* **or OKRUD)—**defined as the integrated totality of various reconnaissance, software, strike, and countermeasure forces and hardware that are covered by a common, uninterrupted, automated control in close-to-real time. Integration creates continuity between the processes of reconnaissance of important enemy facilities; the transmission, processing, and

[117] Ibid., pp. 145-146.

presentation of intelligence data; and the identification, target indication, precision, and autonomous homing of guided weapons to top-priority targets.[118]

Reconnaissance-electronic-fire (strike) system (REOS) of a combined arms formation (*разведывательно-электронно-огневая (ударная) система (РЭОС) общевойского формирования*) – organizationally, informationally, and technically integrated totality of forces and means of reconnaissance, fire destruction, and radio-electronic warfare (when the latter is present in the structure of the combined arms formation), linked by overall command and control and supporting reconnaissance of enemy targets, their radio-electronic suppression, and precision guidance of guided weapons to them in real time. The following may be considered functional elements (subsystems) of a combined arms formation's REOS: recce-fire (recce strike) complexes (ROK, RUK), recce-electronic complexes (REK), or recce-electronic-fire (strike) complexes (REOK, REUK), operationally established for the period in which combat operations are being conducted, with the specific tasks of fire destruction of the enemy and radio-electronic suppression. Each REUK (REOK) can be designated for reconnoitering and destroying one or several groups of important enemy targets.[119]

The US armed forces "shock and awe" system was said to be an **integrated single spatially distributed reconnaissance-destruction system (***razvedyvatel'no-porazhaiushchaia sistema* **or RPS**). The author stated that information-control, reconnaissance-destruction, and reconnaissance-strike systems of high-precision weaponry have been created in some developed countries of the world, and it was the implementation of information-control systems in a single information domain that changed the nature of military conflicts.[120]

Reconnaissance-fire operations (*разведывательно-огневые действия*) (**ROD)** – operations carried out from the commencement of battle (combat operations), begun, as a rule, with part of the reconnaissance and fire destruction forces and means in the interests of destroying (suppressing) the most important newly identified enemy targets when he is structuring his order of battle for an attack. Fire destruction, in the recommended form of brigade artillery, is delivered by short fire raids with maximum density, using conventional munitions, with a subsequent change of fire positions (completion of antifire maneuver).[121]

Provisional reconnaissance-fire complex (VROK)—The provisional reconnaissance-fire complex, abbreviated VROK, should be understood to mean an integrated system of forces and assets of reconnaissance, weapons, and automated command and control and

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[118] Ye. Gribov, V. Kazaryan, D. Karimov, and V. Khlopyak, "Using Precision Weapons in the Operating Contours of Reconnaissance Strike Activities," *Vestnik Akademii Voennykh Nauk (Bulletin of the Academy of Military Science),* No. 3 (24), 2008, p. 46.

[119] M. I. Karatuev, "Coordinating the Forces and Means of Reconnaissance and Fire Destruction in Operations," *Voennaya Mysl' (Military Thought*), No. 6 1998, pp. 37-41. [Found on page 539 of Vol 2, terminology book]. The author would like to thank Dr. Harold Orenstein for his translation of this definition.

[120] V. Litvinenko, "The Comprehensive Integration of Reconnaissance, Control, and Destruction Systems under Conditions of 21st Century Military Concepts," *Armeyskiy Sbornik (Army Journal*), No. 8 2015, p. 35.

[121] S. N. Petrunkh, "On the Forms and Methods of Fire Destruction of an Opponent by Motorized Rifle Brigade Artillery in a Maneuver Defense," *Voyennaya Mysl' (Military Thought*), No 1 2013, pp. 29-32. [Found on page 548 of Vol 2]. The author would like to thank Dr. Harold Orenstein for his translation of this definition.

support equipment dynamically formed in planning and organizing coordination and used in the subsequent course of combat operations.[122]

Reconnaissance-fire delivery operation (ROO)—The aggregate of simultaneous and successive air, air defense and fire battles, engagements and strikes coordinated and interrelated in terms of goals, missions, place, and time and conducted jointly under a common concept and plan by groupings of reconnaissance, fire engagement, and EW personnel and assets on one or several strategic axes for purposes of crushing the enemy by fire.[123]

The word "kontur"—Russia's use of RUK, ROK, and ROS issues can also involve two other terms, loop and circuit, both understood to be translations of the Russian word *kontur*. The acting chief of the Eastern Military District's Rocket Troops and Artillery, Colonel Sergey Obukhov, discussed the meaning of *kontur* (he used "circuit" in this case) in a 2017 interview:

> The reconnaissance-fire circuity is based on artillery and mortar units and employs artillery reconnaissance/targeting assets, UAVs, and kinetic artillery assets, while the reconnaissance-strike circuit consists of artillery reconnaissance assets, UAVs, atmospheric measurements and fire control, as well as 'Uragan' multiple launch rocket system (MLRS) units.[124]

It is not possible to define reconnaissance-strike and -fire circuitry as RUK and ROK, as the "K" is for complex, not circuit (*kontur*), so no abbreviation is provided. Of interest is that the "circuit" functions, first, with a commander tasking a fire mission and, second, then assigning a mission to reconnaissance assets (UAVs, etc.) to get targeting intelligence that, third, is transmitted to artillery assets. Obukhov noted that automated command systems decrease command time by 80 percent and ammunition consumption by 15 percent while increasing target intelligence by a factor of four and damage to targets by a factor of two.[125]

Reconnaissance aircraft [*razvedyvatel'nye letatel'nye apparaty*/RLA] – technical apparatus for conducting air and space reconnaissance. These include piloted and unmanned reconnaissance airplanes, helicopters, drifting balloons, and spaceships. Depending on the nature of the tasks being resolved and conditions of the combat operations, RLA are equipped with the following technical means of reconnaissance: day and night aerial cameras; infrared, laser, and television reconnaissance systems; on-board stations for reconnoitering the parameters of ground, ship, and air radar stations; panorama radar stations and side-scan radar stations; a system for reconnoitering all types of radio communications, the ground and air radiation situation, et al. Some RLAs have means of destruction and are able to destroy important targets that have been detected (see reconnaissance-strike complex).

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[122] V. Litvinenko, "Organization of Coordination: Provisional Reconnaissance-Fire Complex (VROK), Mission, Composition, Combat Capabilities," *Armeyskiy Sbornik (Army Journal*), No. 8 2018, pp. 23-24.
[123] V. M. Barynkin, "The Effect of Precision Weapons on the Character of Combat Operations and the Development of Military Art," *VOORUZHENIYE, POLITICA, KONVERSIYA (ARMAMENTS, POLITICS, CONVERSION*), No. 3 1996, p. 20.
[124] Obukhov.
[125] Ibid.

The following are the principal advantages of piloted reconnaissance airplanes:

- capability of flexible maneuver (actively search for targets; change altitude, speed, and direction of flight; can used various types of reconnaissance systems, depending on conditions);
- rapid assessment of obtained information
- rapid transmission to their command.

Their shortcoming is their vulnerability to air defense resources.

In comparison with piloted airplanes, unmanned reconnaissance airplanes have a number of advantages:

- no danger of losing the crew
- comparatively low cost
- relatively simple to use
- no need for airfields
- ability to fly in areas with high levels of radioactive contamination.

Helicopters can also be used to conduct radar and radiation reconnaissance. Free-flight balloons are employed for aerial photography and radio-technical and meteorological reconnaissance. Streaming air currents are used for their flight at stratospheric and mesospheric altitudes, which have seasonal steady trajectories. The high flight altitude and weak radar contrast of drifting balloons make it difficult to fight against them.

Characteristics for space RLAs are the globality of their operations, ability to monitor enormous areas of the earth in a short time, the high precision in determining the coordinates of military and industrial targets, etc. Unmanned reconnaissance spaceships (see artificial satellites) are employed to conduct reconnaissance with the help of optical-electronic and radio-electronic resources, including aerial photography and meteorological reconnaissance. They can detect ICBM launches, monitor nuclear explosions, et al. Piloted spaceships can make long flights in space, and they have integrated reconnaissance equipment. The range of altitudes for their flight is 200-400 kilometers.[126]

[126] *Military Encyclopedia*, Moscow Military Publishing House, 2003, Volume 7, p. 146.

APPENDIX TWO: ROK DIAGRAM WITH KEY TO ABBREVIATIONS

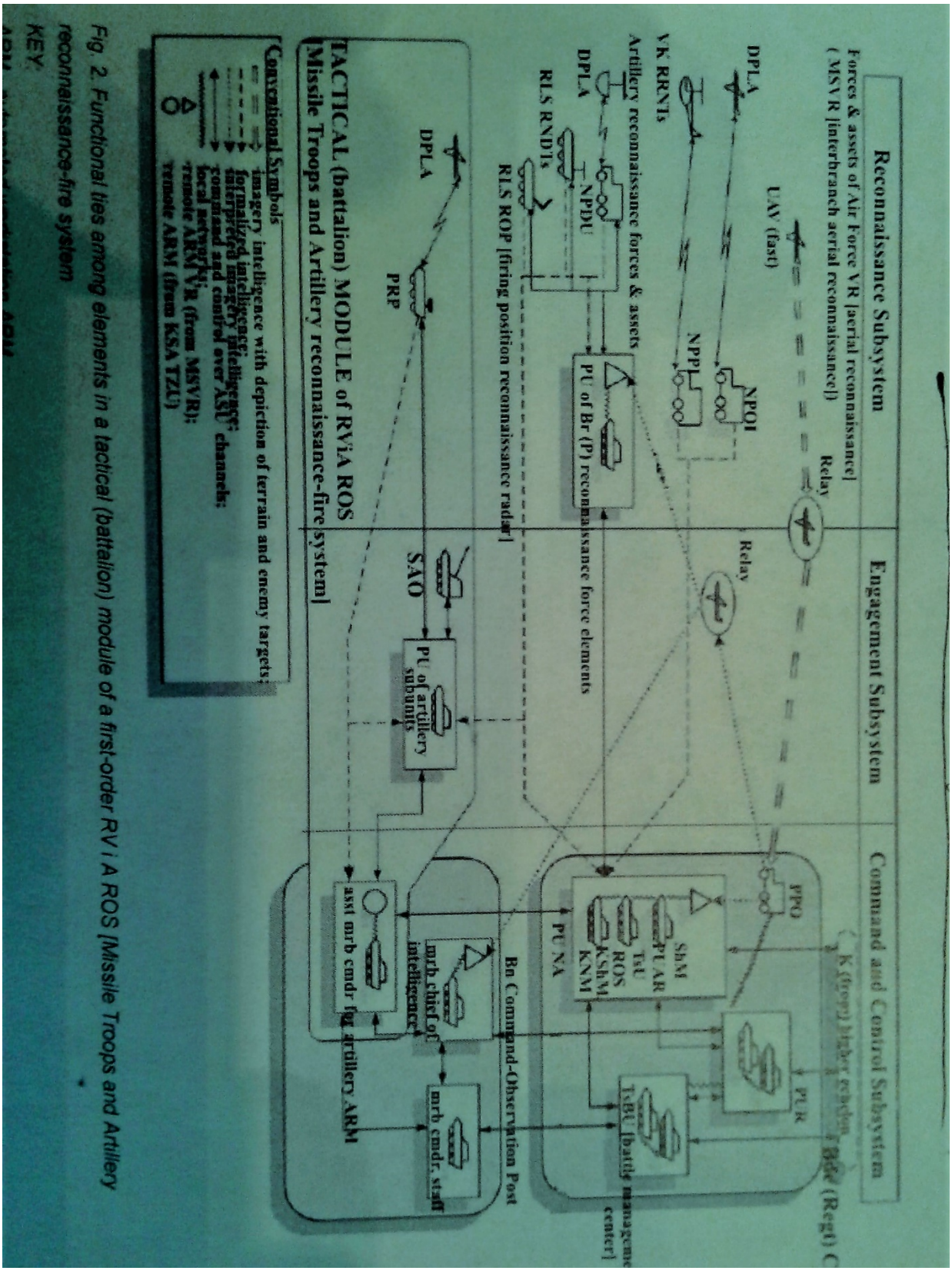

Fig. 2. Functional ties among elements in a tactical (battalion) module of a first-order RV i A ROS [Missile Troops and Artillery reconnaissance-fire system

KEY:

Key (as of 2017):
ARM—automated workstation ARM
VR—aerial reconnaissance automated workstation
ASU—automated control system
Br (P)—brigade (regimental)
DPLA—remotely piloted aerial vehicle
K—commander
KNM—command-observation vehicle
KNP B—battalion command-observation post
KP Br (P)—brigade (regimental) CP
KSA TZU—tactical control echelon automation equipment complex
KShM—command and staff vehicle
msb—motorized rifle battalion
MPDU—not further expanded, possibly ground remote control post
NPOI—not further expanded, possible ground data processing post
NPPI—not further expanded, possibly ground data reception post
NR msb—motorized rifle battalion chief of intelligence
PPO—not further expanded, possibly initial processing post
PRP—mobile reconnaissance post
PU—command and control facility
PU NA—not further expanded, possibly ground artillery command and control facility
PUR—reconnaissance command and control facility
RLS RNDT's—moving ground target reconnaissance radar
RLS ROP—firing position reconnaissance radar
SAO—self-propelled artillery piece
ShM puAR—staff vehicle of artillery reconnaissance command and control facility
TsBU—battle management center
TsU ROS—reconnaissance-fire system command and control center
VK RRNTs—ground target radar reconnaissance airborne complex.[127]

[127] V. Litvenko and S. Voronkov, "Artillery Fire and Maneuver," *Armeyskiy Sbornik (Army Journal)*, No. 2 2017, p. 36.