ANALYSIS

THE RISE OF RUSSIA'S MILITARY ROBOTS
THEORY, PRACTICE AND IMPLICATIONS

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Cover page photo: A young man takes part in the IT-Storm smart festival held by the Budyonny Military Academy of the Signal Corps, Russian State Scientific Centre for Robotics and Technical Cybernetics and Didakticheskiye Sistemy (Sergei Konkov/TASS/Scanpix)

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LIST OF ABBREVIATIONS

ACT	Allied Command Transformation
AI	Artificial Intelligence
APC	Armoured Personnel Carrier
APEC	Asia-Pacific Economic Cooperation
APS	*Avtomat podvodnyy spetsialnyy* (Special Underwater Assault Rifle)
ASU	*Avtomatizirovannaya sistema upravleniya* (Automated Control System)
AVN	*Akademiya voyennykh nauk* (Academy of Military Sciences)
BMP	*Boyevaya mashina pekhoty* (Infantry Fighting Vehicle)
C2	Command and Control
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, Reconnaissance
CD&E	Concept Development and Experimentation
CONOPS	Concept of Operations
EDF	Estonian Defence Forces
EDL	Estonian Defence League
EEZ	Exclusive Economic Zone
EOD	Explosive Ordnance Disposal
EU	European Union
EW	Electronic Warfare
FPI	*Fond perspektivnykh issledovaniy* (Advanced Research Foundation)
FS	Fire Support
GLONASS	*Global'naya navigatsionnaya sputnikovaya sistema* (Global Navigation Satellite System)
GPS	Global Positioning System
GUGI	*Glavnoye upravleniye glubokovodnykh issledovaniy* (Main Directorate of Deep-Sea Research)
HALE	High Altitude Long Endurance
ICBM	Inter-Continental Ballistic Missile
IED	Improvised Explosive Device
IFV	Infantry Fighting Vehicle
ISR	Intelligence, Surveillance, Reconnaissance
ISTAR	Intelligence, Surveillance, Target Acquisition, Reconnaissance
JSC	Joint Stock Company
LLC	Limited Liability Company
LED	Light Emitting Diode
MALE	Medium Altitude Long Endurance
MARS	Mobile Autonomous Robot System
MCM	Mine Counter Measures
MIC	Military-Industrial Complex
MoD	Ministry of Defence
MRK	*Mobil'nyy robototekhnicheskiy kompleks* (Mobile Robotechnical Complex)
NATO	North Atlantic Treaty Organisation
NURS	*Neupravlyayemyy reaktivnyy snaryad* (Unguided Rocket)
OODA	Observe, Orient, Decide, Act
PKT(M)	*Pulemyet Kalasnikova tankovyy (modernizirovannyy)* (Tank-mounted Kalashnikov Machine-gun(Modernised))
R&D	Research and Development
ROS	*Razvedyvatel'no-ognevaya sistema* (Reconnaissance-Fire System)
RBTK	*Robotizirovannyy boyevoy tekhnicheskiy kompleks* (Roboticised Combat Technical Complex)
RTK	*Robototekhnicheskiy kompleks* (Robotechnical Complex)

RUS	*Razvedyvatel'no-udarnaya sistema* (Reconnaissance-Strike System)
SDB	Simonov Design Bureau
S&T	Science and Technology
SKBM	*Spetsial'noye konstruktorskoye byuro mashinostroyeniya* (Special Engineering Design Bureau)
STO	Science and Technology Organisation
TMT	*Tankovyy minnyy tral* (Tank Mine Plow)
TO&E	Table of Organisation and Equipment
TsSVI	*Tsentr voyenno-strategicheskikh issledovaniy* (Centre for Military-Strategic Research)
TTP	Tactics, Techniques, Procedures
UAE	United Arab Emirates
UAS	Unmanned Aerial System
UAV	Unmanned Aerial Vehicle
UGV	Unmanned Ground Vehicle
USV	Unmanned Surface Vehicle
UUV	Unmanned Undersea Vehicle
UZGA	*Ural'skiy zavod grazhdanskoy aviatsii* (Ural Civil Aviation Plant)
VVST	*Vooruzheniye, voyennaya i spetsial'naya tekhnika* (Weapons, Military and Special Equipment)
YeSU-TZ	*Yedinaya sistema upravleniya v takticheskom zvene* (Command and Control at the Tactical Level)

Introduction

Russia's military exercises, operations and defence industry exhibitions are showcasing an increasing number of unmanned aerial, land and maritime platforms. Some examples are dismissed by Western observers as evident failures and signs of unrealistic ambitions, even as a sort of "Potemkin village" display. However, there is no denying the fact that Russia's defence leadership, military theorists and military practitioners are showing keen interest in robotic military applications featuring varying degrees of autonomy in performing their tasks. Moscow's military campaigns against Ukraine and in Syria have become the testbeds of such applications as well as of their integration into the Russian order of battle in conditions of real warfare. Compared to just ten years ago, the Russian Armed Forces have made considerable progress in adopting and expanding the use of these new technologies in their capability development. This process is bound to continue, with some important implications for countries such as Estonia that border Russia and feel threatened by its offensive military capabilities and hostile political intent as well as for the entire NATO alliance, which seeks to deter Russia's military aggression.

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This analysis aims to explore how Russia perceives the value and impact of unmanned systems and platforms in military affairs and how it is preparing itself for the future where such systems enabled by artificial intelligence (AI) and ubiquitous connectivity will reshape the character of warfare. While placing considerable emphasis on this broader conceptual context (Section 1), the paper also seeks to highlight Russia's practical efforts in introducing, testing and further developing these systems for a broad array of functions in various operational domains of warfare and as part of a larger network-centric system of systems (Section 2), and to analyse the implications of these new emerging capabilities for the defence of Estonia and for NATO's technology posture and innovation (Section 3). We conclude that that Russia takes the prospect of roboticised future battlefields very seriously and is preparing for this, both conceptually and in practice. Its progress is driven by its resolve not to fall behind its geopolitical competitors and is supported by an approach to innovation that is tolerant of risk and failure as well as focused on practical results.

1. Theoretical and Conceptual Context

Development of innovative concepts plays an important role in Russian military culture. Although some of their concepts were often unrealistic, the creativity of Russian military innovators helped them overcome some significant practical hurdles or even overtake their opponents in the past. In the context of robotic military systems, development is currently driven by the perception that such systems are actively pursued by other leading militaries, and that Moscow needs to catch up in this process. As one Russian expert notes:

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> The leading developed countries are developing robots which are able to [conduct] combat operations without human intervention. The US armed forces expect that the proportion of robots will be 30 percent of the total composition of

> combat vehicles by 2030. Thus, the combat capabilities of the units equipped with robots will increase [by] 2–2.5 times. Wide application of military robots will change the *basic principles of warfare* [emphasis added]. These changes concern the technical aspects, the human–robot interaction, military tactics and strategy.[1]

In the Russian theoretical debates, unmanned military robotic platforms are characterised as "robotechnical complexes" (*robototekhnicheskie kompleksy,* RTK).[2] However, compared to the Western debate so much focused on terminology and definitions, the Russian approach seems to be less semantic and more practical, as they have not articulated precisely what degree of autonomy—on a spectrum from low-level automation to the highest level of full decision-making autonomy where systems operate without human intervention—and what kind of military functions they are aiming for in the medium or long term. By and large, Russian thinkers and planners see the development of autonomy as gradual evolution in various directions. As every military function such as situational awareness, movement or engagement has its specific challenges and different concepts, Russian military robots will have different levels of autonomy.[3]

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However, this does not mean that the practical approach is divorced from a broader system of ideas. In order to understand how the General Staff and Russian defence planners view military robotic systems and their potential use in combat, it is necessary to contextualise such developments in terms of how Russian military theorists characterise future warfare.[4] Clearly, these theoretical perspectives are influential in shaping Russian defence policy, especially as Moscow seeks to remain competitive and possibly challenging in relation to the world's leading military powers.[5] These views and discussions lead into numerous areas, but two of the main strands within which the Russian conceptual discussion about the development and role of military robots sits are network-centric warfare and the application of military means in conjunction with non-military ones.[6]

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Russian military scientists offer a detailed body of knowledge concerning Western approaches to network-centric warfare, and they tend to analyse the operational experiences of such operations, drawing conclusions about the relative strengths and weaknesses of these approaches. Chief among the Russian military authors on this subject is Colonel Aleksandr Kondratyev, a military technologist who is among the GRU officers tasked with

1. See Sergei Makarenko, "Robototekhnicheskie kompleksy voyennogo naznacheniya - sovremennoye sostoyaniye i perspektivy razvitiya" [Robototechnical complexes of military purpose – contemporary state and prospects of development], *Sistemy upravleniya, svyazi i bezopasnosti* (*Systems of Control, Communication and Security*), no. 2, 2016, 73.
2. Ibid.
3. N. Rudianov and V. Khrushchev, "Kontseptual'nyye voprosy postroyeniya i primeneniya avtonomnykh robototekhnicheskikh kompleksov" [Conceptual issues of building and employing autonomous military robotechnical complexes], *Voyennaya mysl'* (*Military Thought*), no. 6, Vol. 28, June 2019, 55–61.
4. Detailed specialist studies examining the development of military robotic systems have been published in Moscow since 2014. See, for instance, *Robototekhnicheskie Sredstva, Kompleksy i Sistemy Voyennogo Naznacheniya: Osnovnyye polozheniya, klassifikatsiya, metodicheskiye rekomendatsii* [Robototechnical measures, complexes and systems: Main principles, classification, methodological recommendations] (Moscow: FGBU "GNIITS RT", Russian Ministry of Defence, 2014).
5. Makhmut Gareyev, *Srazheniya na Voyenno-Istoricheskom Fronte* [Battles on the military-historical front] (Moscow: INSAN Publishers, 2010), 607; Vladimir Slipchenko, *Voyny Novogo Pokoleniya - Distantsionnyye i Bezkontaktnye* [New generation wars—remote and non-contact], 211–230; Aleksandr Kondratyev, "Stavka na voyny budushchego" [Bet on the future wars], *Nezavisimoye voyennoye obozreniye* (*Independent Military Review*), 27 June 2008.
6. Olga Bozhyeva, "Festival' 'novaya voyna'," *Moskovskiy komsomolets,* 17 October 2009.

studying developments in foreign militaries.[7] During the formative period of Russian military reform under the previous defence minister, Anatoliy Serdyukov, he contributed extensively to furthering and deepening domestic understanding of network-centric warfare by writing on its use and evolution within the US military and the work carried out on this by China.[8] He examined issues such as command and control (C2), speed of decision-making, moving away from platform-centric approaches to warfare, implications for space and airpower, and maritime exploitation, and his work generally cautioned against seeking exclusively technology-based solutions to the deeper issues facing the Russian Armed Forces.[9] He and other Russian military theorists assessing the US experience of network-centric operations conclude that the American variant is principally designed for use against technologically weaker opponents, while they see the need to develop network-centric capability as a tool for use against a stronger high-technology opponent.[10]

Of primary importance in any search for a theoretical background to Moscow's interest in developing military robotic systems is the extent to which the Chief of the General Staff, Army General Valeriy Gerasimov, promotes advanced approaches to modern warfare. Many of the themes and concepts drawn from leading Soviet and Russian military theorists feature in Gerasimov's speeches, revealing some of the roots of current military thought among the General Staff leadership. On 24 March 2018, Gerasimov delineated the contours of Russian thinking on future warfare. Addressing the plenary session of the Academy of Military Sciences (*Akademiya voyennykh nauk*, AVN) at the General Staff Academy, Gerasimov summarised Russian thinking on future warfare as having the following features:

> Broad employment of precision and other types of new weapons, *including robotic ones* [emphasis added], will be fundamental characteristics of future conflicts. The enemy's economy and state command-and-control system will be the priority targets. Besides traditional spheres of armed struggle, the information sphere and space will be actively involved. Countering communications, reconnaissance and navigation systems will play a special role.[11]

Elements of the interface between military science and emerging perspectives on future warfare are clearly present in an article on this theme by Lieutenant-General (retired) Vladimir Ostankov, who examined Russian views on future warfare and showed how this was influencing Moscow's defence posture in many areas. Ostankov is an important author in this regard, as he is a former head of the highly influential Centre for Military-Strategic Research (*Tsentr voyenno-strategicheskikh issledovaniy,* TsSVI) of the General Staff, which is sometimes called "the brain of the Russian military". He asserts that modern warfare increasingly focuses on the application of political, economic, information and other non-military means. He states that this has been exploited during Russian military operations in Syria, mixing military and non-military means in its application of power. On this basis, Ostankov claims the present Russian political leadership has augmented traditional deterrence by adopting a deliberate policy of intimidating potential adversaries.[12]

However, Ostankov believes that the dominant role in future warfare will remain rooted to the

7. Jacob W. Kipp, "Promoting the New Look for the Russian Armed Forces: the Contribution of Lieutenant-Colonel Aleksandr Kondratyev," *Eurasia Daily Monitor,* Vol. 7, Issue 113, 11 June 2010.
8. Aleksandr Kondratyev, "Medal za . . . reformirovaniye" [A medal for … reforming], *Voyenno-promyshlennyy kur'yer* (*Military-Industrial Courier*), 3 October 2007; A. Kondratyev and M. Shchukin, "Razvedyvatel'noye obespecheniye boyevykh deystviy sukhoputnyhk voysk SShA v gorodskikh usloviyakh" [Intelligence support for the military operations of the US ground troops], *Zarubezhnoye voyennoye obozreniye* (*Foreign Military Review*), No. 9, September 2008; Aleksandr Kondratyev, "Obshchaya kharakteristika setevykh arkhitektur, primenyayemykh pri realizatsii perspektivnykh setetsentricheskikh kontseptsiy vedushchikh zarubezhnykh stran" [General characteristics of the network architecture, used in applying prospective network-centric concepts of leading foreign countries], *Voyennaya mysl',* no. 12, December 2008, 63–74.
9. Aleksandr Kondratyev, "Nekotorye osobennosti realizatsii kontseptsii 'setetsentricheskaya voyna' v vooruzhennykh silakh KNR" [Some peculiarities of the realisation of the concept "network-centric warfare" in the PLA], *Zarubezhnoye voyennoye obozreniye,* no. 3, 2010, 11–17; Kondratyev, "Stavka na voyny budushchego"; Aleksandr Kondratyev, "Realizatsiya kontseptsii 'setetsentricheskaya voyna' v VVS SShA" [Realisation of the concept "network-centric warfare" in the US Air Force], *Zarubezhnoye voyennoye obozreniye*, no. 6, May 2009.
10. A. Bogdanov, S. Popov & M. Ivanov, "Perspektivy vedeniya boyevykh deystviy s ispol'zovaniyem setetsentricheskikh tekhnologiy" [Prospects for conducting military actions using network-centric technologies], *Voyennaya mysl',* no. 3, 2014, 3–12.
11. Roger McDermott, "Gerasimov Outlines Russian General Staff's Perspectives on Future Warfare," *Eurasia Daily Monitor,* Vol. 15, Issue 50, 3 April 2018.
12. Vladimir Ostankov, "Ustrasheniye giperzvukom" [Intimidation with hypersonics], *Voyenno-promyshlennyy kur'yer,* no. 20 (783), 28 May 2019.

application of kinetic force. He refers to the changing face of warfare and its implications for the future:

> New technologies have significantly reduced the spatial, temporal and informational gap between troops and command and control. Frontal collisions of large groups of troops (forces) at the strategic and operational levels are gradually becoming a thing of the past. A remote non-contact impact on the enemy becomes the main way to achieve the goals of the battle and operation. The destruction of its objects is carried out to the entire depth of the territory. The differences between the strategic, operational and tactical levels, offensive and defensive actions are erased.[13]

In terms of the future, Ostankov argues that AI will play a much greater role in the wars of the future, robotising the battlefield—but not entirely negating the need for human involvement. Drawing upon Russia's operational experiments in Syria with network-centric warfare capability, Ostankov asserts this has significant implications for Moscow's planning for future wars:

> Anticipating a similar change in the nature of the struggle, the military strategy develops requirements for the development of interspecific reconnaissance-strike and reconnaissance-fire complexes, determining their place in the combat system and sharing participation in the destruction of the enemy. No wonder that a unit has been created within the General Staff of the Armed Forces of the Russian Federation to deal with this problem.[14]

The theme of "robotising the battlefield" therefore seems to have an important role in Russian military thinking concerning future warfare, and it is highly likely that the General Staff specialist unit referred to by Ostankov is also playing a key role in formulating planning on the requirements for military robotic systems and how these may fit into Russia's wider adoption of C4ISR (Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance) capabilities in its armed forces.

The theme of "robotising the battlefield" seems to have an important role in Russian military thinking concerning future warfare

Another, perhaps more significant and deeper, insight into Russian perspectives on future warfare comes from the TsVSI authors, Colonel (Reserve) S. Chekinov and Lieutenant-General (retired) S. Bodgdanov. On the impact of new weapon systems in shaping future wars, they assert:

> Beyond a doubt, new weapons and military hardware have always produced a strong effect on what fighting was all about. In future wars, their nature and substance will be impacted by weapons designed on new physical principles. The nature and substance of future wars will be changed radically by space-based attack weapons, orbiting battle space stations (platforms), new weapons of improved destructive power, range, accuracy, and rate of fire, greater capabilities of reconnaissance and *robot-controlled assets*, *automated weapons control* [emphasis added], communication, and information warfare systems … Weapons designed on new technological principles—high-precision weapons based on several platform varieties, aerospace attack weapons, strike- and fire-capable reconnaissance systems, *remote-controlled* and piloted aerial vehicles, and *robot-controlled weapons* [emphasis added]—will provide for an overwhelming superiority.[15]

While these military theorists confirm that combat robotic systems will certainly play a role in future warfare, which is a theme frequently found in the speeches or interviews given by leading Russian defence officials, they offer no tangible insight into how this may be quantified. Ostankov, as noted, though referencing the robotic dimension of future warfare, sees no reduction in the need for the human element on the battlefield.[16] It thus appears that, overall, Russian military thinkers believe that a "trigger" for military robots employed in

13. Ibid.
14. Ibid.

15. S. Chekinov and S. Bodgdanov, "Razvitiye sovremennogo voyennogo iskusstva s tochki zreniya voyennoy sistemologii" [The development of modern military art in terms of military systemology], *Voyennaya mysl'*, no. 6, 2015.
16. Ostankov, "Ustrasheniye giperzvukom."

combat and combat support roles will remain in the hands of a human operator.[17] It is not certain whether this "trigger" could also mean full authorisation to a robotic combat system to fulfil its mission autonomously, within a given tactical and informational framework. It is, however, evident that—compared to the Western approach based on underlining the high value of soldiers' lives and thus the aim of bringing autonomous systems to the battlefield as a means to save them—the Russian purpose in pursuing robotic systems is to increase the operational impact.[18] Taking the operator out of the machine and fighting remotely allows new tactics and techniques to be implemented and impact to be achieved without being hampered by such factors as fear, stress and fatigue. Similarly, in some circumstances, greater autonomy of robotic systems (i.e. eliminating the need for remote control by a human operator) may create additional operational and tactical advantages or resolve problems that hamper performance in the field (such as the need to maintain secure communications between robots and the command posts), which undoubtedly incentivises the Russian military to see greater autonomy of military robots as a potential solution.

Overall, Russian military thinkers believe that a "trigger" for military robots employed in combat and combat support roles will remain in the hands of a human operator

A crucial element in the Russian military thinking is the automation and roboticisation of field artillery to enhance accurate and timely firepower. An important article in *Armeyskiy sbornik* (*Army Digest*) on combat robotic complexes discussed the appearance of and the need for such systems as part of a wider fire-engagement robotic complex. The authors advocate automating artillery fire to reduce the reloading time. They refer to retrofitting models of weapons in the existing inventory "using modular designs or attachable equipment, which provides [for] their crewless employment in the remote-controlled mode or through the development of specialised military remote-controlled, semi-automatic and automatic robotic complexes."[19]

They went on to elaborate the potential uses of and requirements for such complexes for the Russian Ground Forces (see Annex A). While this list of the potential uses of robots for ground-based operations is extensive, the authors lament the lack of progress in applying AI systems to field artillery and set out proposals to remedy this. Judging from this article, which appeared in the leading tactical journal of the Russian Ground Forces, it can be seen that there is not only ongoing theoretical understanding and discussion in the area of combat robotic systems but also an identifiable demand for these systems at strategic, operational and tactical levels, with commanders already considering the utility of such assets. This is further underscored by the appeal made by these authors based on the Missile Troops and Artillery chief, Lieutenant-General M.M. Matveyevskiy, noting that

A crucial element in the Russian military thinking is the automation and roboticisation of field artillery to enhance accurate and timely firepower

> the automation of the artillery units and subunits is one of the priority directions of the development of the Missile Troops and Artillery. The high level of equipment of the artillery formations with robotic systems will provide them with the capability to conduct contemporary network-centric wars, including based upon the group employment of the military robotic complexes.[20]

17. See Samuel Bendett, "Red Robots Rising: Behind the Rapid Development of Russian Unmanned Military Systems," The Strategy Bridge, 12 December 2020; Russian Federation, "Examination of various dimensions of emerging technologies in the area of lethal autonomous weapons systems, in the context of the objectives and purposes of the Convention," CCW Group of Governmental Experts, 10 November 2017.
18. "In [a] combat situation a soldier makes only 15–20% of their decisions consciously," claimed Oleg Petrashko, Senior Research Engineer of the Centre for Research and Testing of Robotics at the Russian MoD, in an interview. "Vikhr: Reborn as Robot. Russian UGV equipped with drones and a precision battle module," RT Documentary, 7 October 2018.
19. S. Zyuzin, S. Umerenkov & S. Shadrin, "Voyuyut roboty" [Robots fight], *Armeyskiy sbornik* (*Army Digest*), May 2019, 15–23.
20. Ibid.

It is also important to note that Russia is developing its capabilities consciously against a technically more developed adversary (although there is equality or even advantage for Russia in some capability areas, such as electronic warfare). Based on recent wars in which Russia has been involved, its future concept of warfare will be other than traditional and template-based. Key elements will be surprise and speed, by executing operations in audacious and varied ways.[21] Although the backbone of the Russian method of warfare is still the use of massive firepower, Russia is certainly able and willing to add new components in order to create conditions conducive to success. Creating a disposition to machines taking over functions so far fulfilled by humans provides an opportunity to increase the tempo of operations. According to Ostankov, on the future battlefield "tactical and operational pauses disappear. New technologies have significantly reduced the spatial, temporal and information gap between troops, command and control. … A remote contactless impact on the enemy becomes the main way to achieve the goals of the battle and operation."[22]

Creating a disposition to machines taking over functions so far fulfilled by humans provides an opportunity to increase the tempo of operations

In Russian concepts, robotic systems should be especially useful in offensive operations against deliberate defence. The acceptance of losing machines allows highly lethal systems to be pushed through an adversary's line of defence and the adversary's attempts to slow down and canalise movement to be neutralised. An unmanned spearhead can find and fix the enemy forces and thus help maintain the speed of the main advancing forces.[23] Meanwhile, in defensive operations, sensors and robotic systems can form a first line of defence for initial contact with enemy forces. It is furthermore argued that a robotic infantry company could provide seven times more firepower, consume 20% fewer personnel and operate three times faster.[24] Although these numbers cannot be taken as absolute, they indicate very well the attractiveness to Russia's military planners of introducing robotic systems into the battlefield of the future.

2. Capability Development

Russia's military modernisation over the past decade transformed the structure of the Armed Forces, enhancing combat capability across a broad spectrum of the potential applications for kinetic operations.[25] Among the underestimated areas of this process is Moscow's interest in exploiting AI for military purposes, including in development of robotic systems for combat and combat support functions.[26] These efforts naturally draw upon establishing AI as a strategic priority in civilian science, technology and industrial development.

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2.1. Overarching Policy and Civilian AI

Russian national planning to further develop the potential of AI to boost the economy and support the development of new technologies is undoubtedly a long-term project. This builds on quite significant scientific effort: according to a recent paper by Margarita Konaev and

21. Janne Tähtinen, "Venäjän asevoimien kokemukset viimeaikaisista sodista" [Experiences of the Russian Armed Forces from the recent wars], in *Venäjän asevoimat muutoksessa – kohti 2030-lukua* [Changes in the Russian Armed Forces—towards the 2030s], ed. Pasi Kesseli (Helsinki: Maanpuolustuskorkeakoulu, 2016), 3–32.
22. Ostankov, "Ustrasheniye giperzvukom."
23. Leonid Orlenko, "Proryvnyye roboty" [Breakthrough robots], *Voyenno-promyshlennyy kur'yer*, 21 September 2015.
24. Ibid.
25. Andrey Garavskiy, "Svyaz' reshayet vse" [Communication decides everything], *Krasnaya zvezda* (*Red Star*), 4 June 2010; V. Popov, "Faktor mobil'nosti v sisteme boyevoy gotovnosti Vooruzhennykh Sil" [Mobility factor in the system of readiness of the Armed Forces], *Voyennaya mysl'*, no. 12, December 2007, 44–49.
26. Aleksey Boyko, "Katalog nazemnykh voyennykh robotov razlichnogo naznacheniya"[Catalogue of ground military robots of various purposes], Robotrends, accessed 8 January 2021.

James Dunham of the Center for Security and Emerging Technology, the number of English-language scientific publications by Russian scientists in all AI-related fields has increased six-fold from 2010 to 2018, with particular growth in machine learning (by a factor of 9.5), AI and algorithms (7.6) and robotics (6.2).[27] The same paper suggests that, "[g]iven the dual-use nature of AI and the linkages between Russia's scientific research community and the government, these developments also have important implications for national security".[28]

On 10 October 2019, president Vladimir Putin signed into law the first National Strategy for the Development of Artificial Intelligence (AI) for the Period Until 2030. This strategy document provides a framework for accelerating the development of AI, guiding scientific research, improving training in this field, and complementing Russia's National Digital Economy.[29] Although nothing in the strategy document directly serves to guide or prioritise the harnessing of AI for military purposes, the advances envisaged would benefit the defence ministry as an end-user through dual-use AI technologies.

Russian national planning to further develop the potential of AI to boost the economy and support the development of new technologies is undoubtedly a long-term project

Sam Bendett, an adviser at the Centre for Naval Analysis, notes:

> The strategy is also largely mute on the private sector's role in national AI plans, certainly compared to the U.S. AI strategy. That makes Russia's effort a definitive "top-down" push, with Russian state-run and state-affiliated institutions taking center stage. There are signs that this may be partially corrected – the Russian Direct Investment Fund, a state-run investor, announced a plan with the Russian government to invest in domestic companies developing AI. Questions remain about whether the civilian work will cross over to the Russian military, and vice versa.[30]

Bendett's observation is important not only in identifying the extent to which this process is marked by a "top-down" politically driven effort, with links to competing with foreign countries in this field (especially the United States), but also in highlighting the potential for civilian work to be applied to the military arena.

Naturally, this linkage has also been noted by Russian specialists in civilian S&T and industry. In August 2019, the League for Assisting Defence Enterprises in Russia hosted a conference in Moscow bringing together civilian and military AI specialists. The director for AI issues at the Institute of Artificial Intelligence (Russian Academy of Sciences), Gennady Osipov, stressed the strategic importance of AI for Russia, and pointedly linked the non-military and military uses of AI-related technologies. Osipov also suggested that in the information era of military operations, the AI factor could prove to be a decisive factor for the Russian Armed Forces: "One may reasonably argue that a group of countries, a country or a coalition that wields the most powerful means of intellectual analysis of information could become the winner of any conflict even before its official eruption".[31]

Denis Kuskov, director general of the analytical company Telecom Daily, also pointed out that AI and big data technologies can be exploited with greater efficiency and to great effect in the military. He noted that

> Big Data technology makes it possible to transfer virtually unlimited amounts of data, including video, text and graphic information. In battle, this data will come from military personnel, equipment, [and] various reconnaissance equipment, including unmanned aerial vehicles. All this will happen in real time. Using an artificial intelligence system, information

27. Margarita Konaev and James Dunham, "Russian AI Research 2010 to 2018: Topics, Trends, and Institutions," CSET Issue Brief, Center for Security and Emerging Technology, October 2020, 8.
28. Konaev and Dunham, "Russian AI Research," 1.
29. President of Russia, "Ukaz Prezidenta Rossiyskoy Federatsii 'O razvitii iskusstvennogo intellekta v Rossiyskoy Federatsii'" [Decree of the President of the Russian Federation "On the development of artificial intelligence in the Russian Federation"], Decree no. 490, 10 October 2019.
30. Sam Bendett, "Sneak Preview: First Draft of Russia's AI Strategy," *Defense One*, 30 September 2019.
31. "Eksperty OPK: tekhnologii iskusstvennogo intellekta dolzhny stat' drayverom razvitiya rossiyskoy promyshlennosti" [Experts of the defence-industrial complex: artificial intelligence technology must become a driver for development of Russian industry], Soyuz mashinostroiteley Rossii (Union of Russian Machine Builders), 13 August 2019.

> will be instantly processed, synthesised and analysed. This will undoubtedly help the commander understand and decide how best to use the troops and resources.[32]

This observation not only echoes the thoughts of Russian military theorists but also reflects how the Russian technology sector sees itself in relation to military priorities, particularly the development of capabilities for network-centric warfare.

In the information era of military operations, the AI factor could prove to be a decisive factor for the Russian Armed Forces

2.2. Network-centric Capabilities

Since Russia's political-military leadership initiated its reform of the Armed Forces in 2008, developments within the force structure, education, training and tactics, doctrine, military thought, procurement priorities and military modernisation have been largely driven by the adoption of C4ISR and experimentation with network-centric warfare. This has been especially noticeable during Russia's operations in Syria. The process is, however, uneven and contains anomalies. For example, the Russian C4ISR agenda for the Armed Forces' development seems not to envisage the entire structure becoming network-enabled.

The Russian military do not appear to be influenced to the same extent as their Western counterparts by risk reduction and ethical considerations related to implementing AI in military decision-making

In line with the priority emphasis in the modernisation programme, Moscow's exploitation of AI for military purposes is making its most significant advances in the area of C2, which will impact on the speed and efficiency of C2 in future Russian military operations. As part of its adoption and integration of C4ISR capability, Russia's defence leadership is placing growing emphasis on the use of AI to enhance automation of its C2 system. The recent testing of this overall automated control system (*avtomatizirovannaya sistema upravleniya,* ASU) during the strategic exercise *Tsentr* (*Centre*) 2019 included its most advanced examples. This involved the *Akatsia*-M, *Andromeda* (Airborne Forces variant) and the Unified System for Command and Control at the Tactical Level (*yedinaya sistema upravleniya v takticheskom zvene*, YeSU-TZ).[33]

As part of its adoption and integration of C4ISR capability, Russia's defence leadership is placing growing emphasis on the use of AI to enhance automation of its C2 system

ASU is a clear example of Russia's systematic approach to building capability necessary to outplay adversaries in the OODA (Observe-Orient-Decide-Act) cycle. By design, the commanding system of Russian tactical level is simple: the speed of decision-making is already high as its shortness and simplicity provide opportunity for great operational flexibility. Compared to the approach common in Western countries, Russian tactical commanders use a set of standard options to decide how to fulfil a mission. This keeps staff numbers low and planning processes minimal, thus allowing a faster OODA cycle.[34] Using extended automation in a number of C2 processes and introducing AI-enabled solutions will allow Russia to compress this cycle even further.[35] In addition, the Russian military do not appear to be

32. Aleksey Ramm, Aleksey Kozachenko & Roman Kretsul, "Pamyatnaya bigdata: generalam pomozhet iskusstvennyy intellect" [Memorable big data: artificial intelligence will help generals], *Izvestiya*, 13 November 2019.

33. Aleksey Ramm, Aleksey Kozachenko & Bogdan Stepovoy, "Kod v sapogakh: voyennyye razrabotali boyevoy antivirus" [Code in the Boots: The military developed a combat antivirus], *Izvestiya*, 31 October 2019.

34. Lester W. Grau and Charles K. Bartles, *The Russian Way of War: Force structure, tactics, and modernization of the Russian Ground Forces* (Fort Leavenworth, KS: Foreign Military Studies Office, 2016), 38–39.

35. Roger McDermott, "Moscow Showcases Breakthrough in Automated Command and Control," *Eurasia Daily Monitor,* Vol. 16, Issue 164, 20 November 2019.

influenced to the same extent as their Western counterparts by risk reduction and ethical considerations related to implementing AI in military decision-making, which gives a certain edge in terms of open-minded exploration of new opportunities for moving towards greater automation of decision-making and even autonomy of military systems.

In November 2019, Russia's defence ministry announced a major breakthrough in automated C2, referring to the Battle Management Information System (*informatsionnaya sistema boyevogo upravleniya*, ISBU). The ISBU is a sub-system of ASU that coordinates and analyses the continuous exchange of data between command posts, headquarters and troops. Its breakthrough relates to unifying AI and big data technologies to analyse combat situations and provide, through the automated C2, possible options for commanders in the field. It is designed to collect data from all services and sources. For instance, reconnaissance systems, including unmanned aerial vehicles (UAVs) and satellites, have reportedly been integrated into the system, permitting the collection of information about the enemy in near real time. (A recent example of testing a so-called "swarm" of UAVs in the exercise *Kavkaz* (*Caucasus*) 2020 provides a hint of how a range of unmanned ISR platforms will operate as part of this broader system.)[36] It then processes data and develops solutions within seconds. The various scenarios presented to the commander are ranked, starting with the most potentially successful. Consequently, this slashes the time an individual commander will spend making a decision and increases its accuracy.

By 2030 or so, Russia is likely to possess a much more advanced and viable network-centric capability, which will prove challenging for US and NATO military planners

Moreover, two significant building blocks of Russian network-centric warfare capability—the Reconnaissance-Strike System (*razvedyvatel'no-udarnaya sistema*, RUS) for the coordinated employment of high-precision long-range weapons and the Reconnaissance-Fire System (*razvedyvatel'no-ognevaya sistema*, ROS) for coordinated employment of tactical artillery—have also seen significant advances that encompass integration of UAVs as a critical enabler and force multiplier.[37] Writing about the development of ROS, Russian military analysts noted:

> As of today, validation tests are being conducted and multifunction fire support military robotic complexes, which accomplish combat missions for the destruction of armoured and soft targets, and also enemy personnel in visual range of up to 4–6 kilometres are being accepted into the inventory. Beginning in 2020, they plan the delivery to the troops the *Koalitsiya*-SV 2S35 152-millimeter inter-branch artillery complex. In this complex, all of the processes (loading the ammunition load, charging, guidance, and so forth) have been automated. The declared firing range of 70 kilometres will support the accomplishment of hard-kill missions in support of Ground Forces units and formations.[38]

By 2030 or so, Russia is likely to possess a much more advanced and viable network-centric capability, which will prove challenging for US and NATO military planners; but this capability is more relevant in conflict situations on Russia's periphery, where Moscow already possesses temporal and geographical advantages apparent in NATO's defence concerns.[39] Among these capabilities, the AI and autonomy applied in robotic systems will play an increasingly important role.

2.3. Military Robotics

While Moscow's pursuit of AI for military purposes is underestimated in Western policy circles, it is also apparent that research and development (R&D) on military robotic systems is relatively well advanced and in high demand within the Russian Armed Forces. This area of

36. "Swarm of drones used in Kavkaz-2020 exercise first time against enemy forces," TASS, 24 September 2020.

37. See Lester W. Grau and Charles K. Bartles, "The Russian Reconnaissance Fire Complex Comes of Age," The Changing Character of War Centre, Pembroke College, University of Oxford, May 2018.
38. Zyuzin, Umerenkov & Shadrin, "Voyuyut roboty," 18.
39. See Wesley Clark, Jüri Luik, Egon Rams & Richard Shirreff, *Closing NATO's Baltic Gap* (Tallinn: International Centre for Defence and Security, 2016).

technology does not lack engagement from the highest levels of leadership, as the defence minister personally leads the Commission for the Development of Robotic Systems for Military Purposes. However, there is no publicly available information on the scale of that R&D. Many prototype systems have, for example, been tried and tested in Russian military operations in Syria.[40] Moscow, like London and Washington, has also consistently opposed an international ban on such R&D or imposing any regulatory framework.[41]

By some accounts, Russia has the second-largest UAV fleet in the world, and the use of unmanned aerial systems is integrated in units in all domains—land, air and sea

Overall, Russia's advances in developing military robotic systems and platforms (see Annex B) have already been significant. As a result, by some accounts, Russia has the second-largest UAV fleet in the world, and the use of unmanned aerial systems (UAS) is integrated in units in all domains—land, air and sea.[42] The development of unmanned land systems, from both the technological and conceptual perspective, is also being promoted strongly by the defence ministry. Although technical challenges mean that robotic land complexes will not be used to their full extent within the next 10–15 years, as assumed by Russian planners, the gradual employment of military robots, at least in some environments such as urban areas, is anticipated by 2025.[43] The maritime domain is also emerging as an important strand of efforts by the Russian military to explore the potential of robotic systems such as unmanned undersea vehicles (UUVs).

Combat deployments in Ukraine and Syria have provided the defence ministry and the Russian defence industry with ample opportunity to test new equipment. This is particularly true when it comes to Syria, where the Russian Armed Forces showcased its most eye-catching weapon systems and platforms, such as the new air-, submarine- and surface-launched cruise missiles, the Project 636.6 *Varshavyanka*-class submarine, and the Sukhoi Su-57 fifth-generation fighter aircraft.

However, in addition to these manned platforms, both theatres have also shown the progress Russia has made in developing, testing and incorporating various robotic systems into its capabilities.

2.3.1. Air Domain

Russian deniability of its involvement in the war in the Donbass had a restrictive impact on the platforms Moscow chose to employ against the Ukrainian Armed Forces. Consequently, Russian forces and their proxies limited the use of robotic assets to UAVs. Operations in this theatre showed the extent to which Russian ground troops had incorporated and mastered the use of UAVs for target detection, precise targeting, and post-strike assessment in artillery operations. These included almost all Russian UAVs currently deployed in ground units, such as *Granat*-1, *Granat*-2, *Forpost*, *Orlan*-10, *Eleron*-3SV, *Zastava* and *Takhion*.[44] The addition of electronic warfare payloads make these systems important support assets in ground operations as they hinder the C4ISR capabilities of enemy forces. Indeed, apart from standard ISR equipment, Russian UAVs often carry electronic warfare (EW) equipment for jamming navigation systems and GSM networks and/or radio suppression, or sending false text messages to enemy infantry

Combat deployments in Ukraine and Syria have provided the defence ministry and the Russian defence industry with ample opportunity to test new equipment

40. "Novyy trenazher parashyutista pokazhut na forume 'Armiya-2019'" [New trainer of a paratrooper will be shown at the forum Army-2019], BMF, 28 May 2019.
41. Patrick Tucker, "Russia to the United Nations: Don't Try to Stop Us From Building Killer Robots," *Defense One*, 21 November 2017.
42. Samuel Bendett, "The Rise of Russia's Hi-Tech Military," *Fletcher Security Review*, American Foreign Policy Council, 26 June 2019.
43. "Istochnik: v RF razrabotayut taktiku primeneniya robotov v ulichnyh boyakh" [Source: tactics of use of robots in urban combat will be developed in the RF], RIA Novosti, 24 November 2019.
44. "The ninth Russian drone type identified in Donbas," InformNapalm, 9 June 2018.

personnel on the ground. Consequently, UAVs serve as a significant force multiplier. This realisation has already had an impact on the table of organisation and equipment (TO&E) of ground units. For instance, each manoeuvre and artillery brigade has an organic UAV company attached to it.

The proliferation of UAV capability among Russian ground forces units and its successful employment in combat operations is testament to the progress the Russian military-industrial complex (MIC) has made in developing ISR UAVs as well as the ground forces' successful integration of UAVs in mechanised and artillery units. This is particularly true given that in Georgia in 2008 Russian UAV performance was very poor.[45]

However, despite these advances in technology and integration, the Russian MIC is yet to develop a strike-capable UAV, which places Russia almost two decades behind the United States in developing them (the first American UAV kill occurred in October 2001[46]). Although Sukhoi unveiled the S-70 *Okhotnik* (*Okhotnik*-B) "stealthy" heavy UAV in January 2019 with the system making its debut flight in August that year, it remains to be seen whether both stealth and strike technologies have been successfully integrated into the vehicle. The same applies to the *Altius*-U UAV, a Russian equivalent of the US long-range MQ-9 *Reaper*, which also flew for the first time in August 2019. This deficiency is clearly manifested in Syria, where battlefield space is significantly larger than in Ukraine. A lack of strike-capable UAVs that can undertake long-range, deep-strike missions necessitates the use of manned aviation, which is costly and can put a strain on maintenance services of fixed- and rotary-wing fleets, especially in high-tempo operations.

The proliferation of UAV capability among Russian ground forces units and its successful employment in combat operations is testament to the progress

In the meantime, in August 2019, the decision was announced to equip all *Iskander* brigades with *Orlan*-10 UAVs.[47] However, with only a 120km range for the *Orlan* and 500km for the *Iskander*-M, it is unclear how these two can be integrated, especially in highly contested environments. Russia is in dire need of a long-range and long-endurance UAV, such as *Altius*-U, to provide ISR and targeting data to fully utilise its stand-off strike capability delivered by *Iskander*, *Bastion*-P, *Bal*, Kh-101 and the *Kalibr* family of missiles.

Russian troop deployments in Ukraine and Syria have allowed the Russian MIC and the Ministry of Defence to test unmanned assets in low-intensity combat environment. A lack of sophisticated air defence capabilities degrades opposing forces' ability to hinder UAV operations, which in turn allows Russia to conduct a wide range of EW and artillery missions. However, the effectiveness of such operations is heavily dependent on the ability of the operator to have an unhindered connection with the UAV. In the event of conflict with a superior adversary such as NATO, the Russian Armed Forces are probably unlikely to enjoy such freedom of operations as the electromagnetic spectrum would be highly contested. Given the salience of geopolitical competition with the West and of NATO's capabilities in Russian military planning, this serves as a powerful motivating factor to pursue the development of more autonomous combat UAVs.

2.3.2. Land Domain

The Russian Armed Forces are also developing unmanned ground vehicles (UGVs) to support infantry operations. They often maintain a pragmatic approach to unmanned systems by utilising old platforms such as the T-72 (*Shturm*) and T-90 (*Prokhod*) main battle tanks and the BMP-3 (*Vikhr*) infantry fighting vehicle to convert these to optionally manned combat systems that could be operated remotely in an unmanned mode. In parallel, field experiments with newly developed unmanned systems such as *Soratnik* and *Uran*-9 in current operations

45. Ariel Cohen and Robert E. Hamilton, *The Russian Military and The Georgia War: Lessons and Implications* (Carlisle Barracks: Strategic Studies Institute, US Army War College, 2011), 49.
46. Arthur H. Michel, "How Rogue Techies Armed the Predator, Almost Stopped 9/11, and Accidentally Invented Remote War," *Wired*, 17 December 2015.
47. Roman Kretsul and Aleksey Ramm, "Po sledu drona: 'Iskandery' poluchat 'glaza i ushi'" [In the trace of a drone: "Iskanders" will get "eyes and ears"], *Izvestiya*, 21 August 2019.

demonstrate the desire to integrate UGVs more comprehensively into their capabilities.

Perhaps at the forefront of this development is the *Uran*-9 UGV. Developed by Kalashnikov Concern, *Uran*-9 features "a remotely operated turret for mounting different light and medium-calibre weapons and missiles."[48] It can be equipped with 9M120-1 *Ataka* anti-tank guided missile launchers and a 30mm 2A72 automatic cannon with 7.62mm coaxial machine gun, which allows for engagement of soft-skinned vehicles, low- and slow-flying aerial targets and manpower. There is also an option to equip *Uran*-9 with the rocket-propelled *Shmel*-M reactive flamethrower and/or *Igla* or *Verba* surface-to-air missiles and 9M133M *Kornet*-M anti-tank guided missiles. In September 2018, it was reported that the *Uran*-9 vehicle had been upgraded and now featured 12 *Shmel* rocket-propelled thermobaric grenades in place of the previous six to increase *Uran*'s effectiveness.[49] The mission envelope is therefore quite sizable as it involves engaging both ground and aerial targets. The vehicle is not intended to undertake independent operations. Instead, the current practice is to utilise it in a support role or as a reconnaissance platform.

Field experiments with newly developed unmanned systems such as Soratnik *and* Uran-*9 in current operations demonstrate the desire to integrate UGVs more comprehensively into their capabilities*

In late 2016, Russian forces in Syria started testing the *Uran*-6 MRTK-R unmanned multifunctional demining system. The vehicle was used in Palmyra, where it undertook mine reconnaissance and area clearance operations, and detected and removed explosive ordnance and anti-personnel and anti-tank mines. The *Uran*-6 can be equipped with five different sweeping devices depending on the tasks assigned, including the *Boikova* self-propelled mine-sweeper, solid milling, tiller, solid roller and *Katkov* demining trawl. In addition to being tested in Syria, the system has already been fielded in military engineering units in the Southern Military District, where it has been used to demine in Chechnya.

Another platform, the *Soratnik* UGV, has reportedly been tested in conditions "approximating" those of Syria to confirm its combat characteristics, although images or videos of the system deployed in Syria are yet to surface. *Soratnik* is similar to the *Uran*-9, although its mission envelope is larger. It is earmarked for reconnaissance and fire-support missions, but can also undertake mine clearance and patrolling duties. The vehicle can operate in fully automatic mode, but it can also be controlled directly by an operator. Interestingly, the system is equipped with tactical UAVs, which indicates efforts to integrate unmanned capabilities across different domains.

Combat experience in Syria is also influencing the Russian concept of operations (CONOPS) for ground missions. Images from Syria clearly show that the employment of UGVs for demining operations is often synchronised with the use of jammers to suppress radio signals in the remote activation of improvised explosive devices (IEDs). Concurrently, the employment of UAVs in both Syria and Ukraine has allowed Russian artillery units to perfect short-range fire. What Russian forces lack, however, are systems to provide ISR capability for ground forces at operational depths. Development of long-range *Okhotnik* and *Altius*-U UAVs, which will also possess strike capabilities, may bridge this gap, probably early in the next decade.

One of the shortcomings of using UGVs is a lack of reliable connection and bandwidth problems. The use of ground systems in urban terrains not only makes signals easier to intercept; buildings also interfere with signal propagation, which can cause dropped signals. This challenge can be mitigated either by using a wire (which poses of risk of entanglement)

Combat experience in Syria is also influencing the Russian concept of operations (CONOPS) for ground missions

48. "Uran-9 Unmanned Ground Combat Vehicle," Army Technology, n.d.
49. Özgür Ekşi, "Russia's Uran-9 to be upgraded," C4Defence, 24 September 2018.

or by deploying a UAV to serve as a signal transmitter. It is understood that the Russian Armed Forces are working on developing the second option, especially in low-level combat environments where UAVs can operate freely. An alternative is to implement AI technology to make a system fully autonomous and thus capable of operating without human intervention. Although it is unlikely that Russian technology and expertise in AI has progressed far enough to allow the deployment of AI-enabled autonomous UGVs in the near future, it is certainly a pathway of technological development that the Russian military will be eager to explore in synergy with the civilian sector's AI investments.

In February 2019, the Advanced Research Foundation (*Fond perspektivnykh issledovaniy*, FPI) in Moscow released a video featuring tests of a promising robotic platform designated as *Marker*. This experimental platform is a joint project of the FPI and NPO *Androidnaya tekhnika*. The system has two anti-tank guided missiles and a Kalashnikov assault rifle. While quite rudimentary in its design, it aims to reduce the role of the operator to increase the overall autonomous capacity of the system. FPI functions at the cutting edge of such research, with its main development areas being autonomous control, image recognition, group interaction, orientation and navigation, technical vision, payload management, and robotics for a combat role.[50] FPI appears to be on the verge of full-scale testing of technologies and basic elements of more autonomous ground-based robotics. According to the FPI website, in relation to the *Marker* project:

Although it is unlikely that Russian technology and expertise in AI has progressed far enough to allow the deployment of AI-enabled autonomous UGVs in the near future, it is certainly a pathway of technological development that the Russian military will be eager to explore

> The evolution of modern military-based ground-based robotic systems (RTKs) is moving along the path of increasing the ability to perform tasks in an autonomous mode with a gradual decrease in operator involvement in the RTK control process. To increase the level of autonomy of ground-based RTKs, the development of a number of key technologies is required, which together determine the appearance of promising RTKs. Therefore, it is urgent to develop robotics technologies and bring them to the level of readiness, which allows using the created technologies on promising autonomous RTKs in real conditions.[51]

Russian planners pay considerable attention to warfighting capabilities in an urban environment when designing robotic weapon systems. This environment will be probably one of the most important, as well as challenging, environments for future deployment of unmanned ground combat systems. Recent conflicts in which Russia has been involved—as well as the negative (and never forgotten) experience from operations in Grozny, the capital of Chechnya—shape and inform this development.[52] Russia's persistent disregard for collateral damage and civilian casualties in these conflicts and its pursuit of increased operational tempo that exceeds the psychological and physical abilities of soldiers—combined with the technical constraints on communications between unmanned ground systems and control stations in urban areas—suggest that Russia might end up going much further in delegating "kill authority" to the machines in combat than its military theorists suggest.

Russian planners pay considerable attention to warfighting capabilities in an urban environment when designing robotic weapon systems

50. "Opublikovano video novogo robototekhnicheskogo kompleksa RF" [Video of a new Russian robotechnical complex have been released], *Voyennoye obozreniye,* 19 February 2019.

51. "Marker: Ekspermental'naya robototekhnicheskaya platforma" [Marker: Experimental robotechnical platform], Fond perspektivnykh issledovaniy (Advanced Research Foundation), n.d.

52. Kelsey D. Atherton, "Russian Army will develop Storm robot tank and Ally," C4ISRNET, 10 January 2020.

2.3.3. Sea Domain

The development of indigenous autonomous underwater vehicles has been overshadowed by what is now called *Poseydon*–a long-range, high-speed, nuclear-powered unmanned underwater vehicle (UUV) with a thermonuclear warhead. The system is designed to travel autonomously across thousands of miles and detonate its reported two-megaton warhead outside an enemy coastal city, making it essentially an underwater ICBM. It is not clear when the system will be deployed, but its main carrier, the submarine *Belgorod* (Project 09852) was launched in April and is earmarked for delivery to the navy in 2021.

Russia can weaponise UUVs and use them to attack ports and critical undersea infrastructure to degrade an enemy's military and economic capacity to fight

A second submarine, *Khabarovsk* (Project 09851), is now nearing completion. *Belgorod* is also capable of launching the *Klavesin*-2R-PM UUV, officially used for oceanographic research and mapping but probably also for clandestine operations.

It should be noted that perhaps at the forefront of Russian autonomous UUV development and employment is the Main Directorate of Deep-Sea Research, or GUGI (*Glavnoye upravleniye glubokovodnykh issledovaniy*). This is an intelligence-collection and special missions unit that reports directly to the Ministry of Defence. It fields submarines, underwater vehicles and surface ships (such as *Yantar*).[53] Although its operations are classified, it is believed that GUGI's missions include bugging underwater communications cables, planting movement acoustic systems, and finding and collecting wrecks from the sea-floor.

As of late 2018, 17 known UUV development programmes were being pursued, according to the head of the United Shipbuilding Corporation, Aleksey Rakhmanov.[54] At least one of these systems, *Galtel*, was reported to have been used off the Syrian coast for sea-floor mapping and monitoring. It was also used to search for unexploded ordnance. *Galtel* is reportedly equipped with AI allowing it to independently analyse situations and make decisions without human intervention.[55]

The Russian Navy is interested in deploying UUVs to provide round-the-clock monitoring of coastal areas and exclusive economic zones (EEZs) to ensure that no hostile vessels (particularly submarines) are able to penetrate Russian defences. At the same time, Russia can weaponise these UUVs and use them to attack ports and critical undersea infrastructure (cables, pipelines, LNG facilities, etc.) to degrade an enemy's military and economic capacity to fight. It is also likely that some vehicles are already used for intelligence collection and gathering information on sea approaches in contested areas, such as the Baltic and the Black seas.

3. Implications

Technological trends such as greater reliance on AI and robotic systems and platforms in military capabilities have not passed Estonia by. As part of the NATO alliance, which has a long history and tradition of successful exploitation of these trends, Estonia has been at the forefront of cyber capabilities development, with AI playing a pivotal role. When it comes to robotic applications and their integration into a system of systems, its efforts have largely been industry-led, while defence planning assumptions remained largely derived from analysis of Russia's traditional capabilities rather than from thorough consideration of its new emerging concepts and capabilities. At the same time NATO, while retaining a significant technological lead, has been slow to appreciate the challenge posed by Russia in this field and how it will affect the Alliance's future strategy and operations.

The implications for the defence of Estonia and NATO of Russia's advances in developing and

53. *Yantar* (Project 22010) is an intelligence-collection ship and mini-sub host. It is designed to conduct recovery missions or undertake undersea engineering missions such as communications cable severance.

54. Svetlana Tsygankova, "V Rossii razrabotayut 17 podvodnykh bespilotnykh apparatov" [Seventeen unmanned undersea vehicles will be developed in Russia], *Rossiyskaya gazeta* (*Russian Newspaper*), 1 November 2018.

55. Nikolay Grishchenko, "Rossiyskiy podvodnyy robot vypolnil boyevuyu zadachu v Sirii" [Russian undersea robot completed a combat task in Syria], *Rossiyskaya gazeta*, 22 February 2018.

deploying unmanned military systems cannot be understood without attempting to outline how Russia's armed forces might operate in a future battlespace and take advantage of those systems. A hypothetical outline of some key elements, presented in Annex C, reflects the logic of what Russian military thinkers have written and applies Russian operational principles or draws on operational patterns the Russians might follow in the context of unmanned systems. Some of the outlined elements are, however, not unique to Russia's military thinking and would probably be first introduced in Western concepts of warfare, which Russia would then try to emulate—as it has previously done in numerous instances (e.g. by pursuing long-range precision-strike capability or networked force concepts).

> *NATO, while retaining a significant technological lead, has been slow to appreciate the challenge posed by Russia*

3.1. Implications for Estonia

3.1.1. Operational and Tactical Issues

Russia's possible use of unmanned aerial systems (UAS) in hybrid conflict would put Estonia's national security and defence system in a complicated situation. Due to technological limitations in air surveillance, situational awareness of small, low-flying and slow aerial objects is inherently difficult even around critical strategic objects such as airports or military bases.[56] If and when hostile UAVs are discovered, the available and anticipated future countermeasures—both kinetic and non-kinetic—would allow control to be exercised only in a very limited number of key areas. Thus, Estonia's military and internal security forces operating counter-UAS (C-UAS) capabilities and conducting synchronised air coordination (which enables counteractions and smooth management of own unmanned and manned assets) would easily become overstretched if they attempted to scale up their response to this threat, leaving most of the infrastructure and population vulnerable to disruption.

> *Russia's possible use of unmanned aerial systems (UAS) in hybrid conflict would put Estonia's national security and defence system in a complicated situation*

The employment of unmanned undersea systems during the hybrid phase would also pose some significant challenges. Subsurface situational awareness in the Baltic Sea is particularly complicated due to unusual hydrological conditions, gaps in Estonia's maritime surveillance capabilities and constraints in the exchange of data among various actors operating in this domain.[57] With sparse maritime capabilities at the disposal of the Estonian authorities, it would be difficult to prevent Russian UUVs deployed in international waters from damaging critical undersea infrastructure (power and data cables, pipelines) or disrupting economically vital shipping routes by posing a threat to maritime safety. Even by purposefully appearing near important ports in Estonia, they could produce detrimental psychological effects on society and undermine the credibility of the security and defence authorities.

During both hybrid and open armed conflict, extensive Russian use of interconnected unmanned ISTAR assets and AI-enabled C2 systems would make it extremely challenging to hide own critical C2 elements, forces, assets and intentions. Given all the layers of the Russian ISTAR system—from space-based sensors to small UAVs—activities such as increasing readiness, mobilising reserves or moving various units would be almost impossible to conceal (if that were the intention of the Estonian government in a particular situation).

In the event of an armed attack, Estonia's usual approach—to create tactical depth with delaying operations—would be less effective because of the unmanned spearhead of the attacking Russian forces. This spearhead

56. See Kyle Carnahan and Darrel Zeh, "Daunting Challenge of Drone Defense," *DSIAC Journal*, Vol. 7, no. 3 (Summer 2020), 42–48.

57. See Heinrich Lange, Bill Combes, Tomas Jermalavičius & Tony Lawrence, *To the Seas Again: Maritime defence and deterrence in the Baltic region* (Tallinn: International Centre for Defence and Security, 2019).

would engage immediately after indirect fire from artillery and missile systems and from a much shorter distance than with manned systems. Neutralising this would absorb much effort of the defending force while leaving the manned forces less affected and thus able to maintain operational speed. In addition, the preparation of delaying operations would be more demanding because of the permanent UAV threat. Command posts, logistics assets, communications systems and other vital parts of the Estonian defence system would be continuously pursued by UAVs capable of precision strikes or by loitering munitions.

In the event of an armed attack, Estonia's usual approach—to create tactical depth with delaying operations—would be less effective because of the unmanned spearhead of the attacking Russian forces

Operations behind enemy lines would have to be executed in the presence of the adversary's unmanned systems. Russian convoys and high-value targets would be protected by the aerial and land-based unmanned ISTAR and combat robots, making the effect of surprise against them hard to achieve. At the same time, Estonia's own unmanned systems would be continuously jammed and their remote-control functions as well as information exchange with platforms would be severely hampered, making them less usable in threatening Russian lines of supply in its rear areas, unless they are given a substantial degree of autonomy. On the other hand, there would be new opportunities to impair the advancing forces' logistics by targeting technical support of the Russian robotic systems; due to the imperative of maintaining high operational speed, this function would need to be positioned relatively close to the main Russian forces to allow expeditious maintenance and repairs.

However, safe havens for Estonian troops would be extremely limited, if they existed at all. Russian situational awareness and ability to continuously operate unmanned ISTAR and unmanned combat systems would allow opposing forces to be engaged without delay, putting the Estonian troops under constant pressure. Only heavy fortifications or constant movement would ensure some degree of survivability. Front-line and rear areas would be under equal pressure. The same applies to civilians and civilian targets, which would also be harassed and attacked by robotic systems in order to influence the nation's morale and resistance. Creating a permanent status of insecurity across the entire territory would affect the defending force's ability to fight and sustain itself by continuously drawing upon reserves.

Depending on further Russian advances in deploying unmanned systems and integrating them into network-centric capabilities, the Estonian Defence Forces (EDF) would have to adapt and change their Tactics, Techniques and Procedures (TTPs) to preserve survivability. Deception would be particularly important in an environment where concealment is not a viable option. Feeding the sensors of the adversary's systems with false indications is an option for survivability in an environment where hiding own troops, equipment and intentions for sufficient periods of time is difficult. In addition, the forces' vital hubs such as command posts and communications centres will need to be small and mobile.

3.1.2. Capability and Organisational Implications

The operational and tactical issues described above illustrate the nature of the challenge that development and deployment of increasingly autonomous weapons systems and military robots could pose to Estonia's defence in the future. Underestimating this challenge could have severe consequences and it therefore needs to be addressed systematically in the framework of medium- and long-term capability planning processes. First, it is necessary to improve awareness of Russian progress in developing and deploying

Russian convoys and high-value targets would be protected by the aerial and land-based unmanned ISTAR and combat robots, making the effect of surprise against them hard to achieve

new robotic (remotely piloted, semi- or fully autonomous) military platforms and systems and their integration into a larger system of systems of network-centric warfare. This would enable Estonia's own R&D and concept development and experimentation (CD&E) efforts to be better focused and to facilitate agile and rapid response to the threats posed by Russia's new capabilities.

Focus, speed and agility in the entire security and defence innovation ecosystem, able to draw seamlessly on knowledge and resources of the government, academia and industry, will be of critical importance to Estonia. In this broad framework, the EDF and other end-users of capabilities need to be able to identify and define the operational challenge stemming from Russia's concepts, experiments and actual employment of military robots. In turn, industry would have to be capable of fast and flexible product development in very close cooperation with the end-users and academia, the latter providing solid scientific knowledge to ensure that cutting-edge technology is incorporated in the pursued solutions.

Safe havens for Estonian troops would be extremely limited, if they existed at all

The internal security agencies such as the police and border guard must get more involved in these processes to achieve common understanding with the military, especially concerning potential uses of unmanned systems in hybrid conflict situations. This, in turn, should lead to some common inter-agency solutions. A shared sensor network for the defence and internal security forces would need to be developed to identify and track unmanned aerial and maritime objects in critical areas. As recent developments show, there is an increasing trend of non-state actors using unmanned systems, both for reconnaissance and attacking purposes, in the air domain.[58] This is all but certain to become a reality in the maritime domain soon as well. The network should be able to perform a highly demanding task of distinguishing between hostile and neutral civil unmanned vehicles, as well as between those deployed directly by the Russian military and security structures or by their proxies.

Estonia would need to invest more in C-UAS systems to create a minimum ability to deal with all types of UAVs and their users. Just like a network of sensors, this capability should also be part of an integrated system shared by military and internal security forces. Maximum integration is also needed to enable own UAV movements—military and civilian as well as government and commercial—during different phases of a crisis. Affordable development of effective and adequate EW capability is also something to consider in the context of countering UAVs. Although EW capability is resource-heavy, effective cooperation between the military and security authorities and academia and industry could provide some affordable options for countering hostile robotic systems.

Deliberate defence in land operations should consider the adversary's ability to break through obstacles and minefields more effectively using UGVs. The human factor will no longer be physically present in road-clearing and demining, so the means that were traditionally effective against manned systems (such as weapons that shake crew members but do not disable machinery) will not have the necessary effect in future. A rapid and smart false mining capability to tie up robotic resources will be increasingly important to reduce the enemy's freedom of action and speed of manoeuvre.

It is necessary to improve awareness of Russian progress in developing and deploying new robotic military platforms and systems and their integration into a larger system of systems of network-centric warfare

Overall, the proliferation of technology provides an opportunity for Estonia to expand the choice of systems available for flexible and rapid adaptation, from highly sophisticated ones down to fairly simple but effective

58. Peter Bergen, Melissa Salyk-Virk & David Sterman, "Non-State Actors with Drone Capabilities", in The World of Drones, New America, last updated 30 July 2020.

solutions. Inexpensive systems—for example, basic UAVs or cheap sensors combined with explosives—can pose a very uncomfortable challenge to the enemy if used on a large scale against both manned and unmanned systems.

However, maintaining the full spectrum of know-how about robotic military systems and platforms and the countermeasures against them is costly and difficult for the security and defence forces of small nations such as Estonia. The EDF, in particular, cannot afford this in sufficient quality and quantity in its permanent structure. The unique composition and position of the Estonian military reserve and the Estonian Defence League (EDL) could provide a solution. Creating a framework for highly qualified reservists and EDL members that provides opportunities and motivates them to be engaged in challenging projects—whether conceptual reflections or field testing and experimentation—would be the most viable approach. The EDL's Cyber Defence Unit, which is an agile pool of competence to support the EDF's Cyber Command, serves as a good template for this.[59]

The EDF and other end-users of capabilities need to be able to identify and define the operational challenge stemming from Russia's concepts, experiments and actual employment of military robots

Russia's military robotic platforms and systems and their potential employment in hybrid and conventional warfare scenarios is an emerging challenge that requires Estonia to combine whole-of-government and whole-of-society approaches in technology and capability development. It is also a challenge for NATO as a whole, which means that those approaches must be well connected with the Alliance's overall approach.

The proliferation of technology provides an opportunity for Estonia to expand the choice of systems available for flexible and rapid adaptation, from highly sophisticated ones down to fairly simple but effective solutions

3.2. Implications for NATO

So far, NATO allies have been ahead of Russia in deploying unmanned aerial systems, including combat UAVs, but no member state has deployed unmanned ground or maritime systems in a way that would have a significant operational impact. It is clear, however, that autonomy of military platforms and systems in all domains of warfare will play an important role in the ongoing capability race between Russia and the Alliance, as both sides appreciate their potential in creating operational advantage and their overall disruptive nature as well as the importance of developing effective countermeasures. In recent years, autonomy has been receiving growing attention in the NATO framework. For example, concerns about losing the cutting edge in the development of autonomy technologies and exploitation of AI were reflected in the NATO Science and Technology Organization's (STO) new thematic approach adopted in 2017, which addressed autonomy and military decision-making using AI and big data as two of the three major thematic areas.[60] NATO Allied Command Transformation (ACT) launched its autonomy programme in 2017.[61] However, in 2018, the NATO Parliamentary Assembly

Russia's military robotic platforms and systems and their potential employment in hybrid and conventional warfare scenarios is an emerging challenge that requires Estonia to combine whole-of-government and whole-of-society approaches in technology and capability development

59. "Estonian Defence League's Cyber Unit," Kaitseliit (Estonian Defence League), last modified 15 October 2020.

60. NATO Science and Technology Organization (STO), *2017 Highlights: Empowering the Alliance's Technological Edge* (Brussels and Paris: NATO STO Office of Chief Scientist & NATO STO Collaboration Support Office, 2018), 11.
61. NATO Allied Command Transformation, "NATO-Industry Forum 2018: Read-ahead package," NATO-Industry Forum, Berlin, 12–13 November 2018, 20.

published a report on the Alliance's efforts to maintain its technological edge that argued NATO could be losing this advantage in several areas. The report highlighted AI and autonomy as a key area of concern, and pointed out that only 4% of NATO's collective S&T effort was dedicated to the subject of autonomy.[62] The same committee's report for 2019 focused exclusively on exploring the implications of AI and autonomous robotic systems and urged the armed forces of the Alliance to "move beyond scanning the horizon and instead invest in real research, experimentation, development, and adoption efforts."[63]

Autonomy of military platforms and systems in all domains of warfare will play an important role in the ongoing capability race between Russia and the Alliance

What makes a big difference between the NATO and Russian approaches is that Russia does not seem to have any particular societal or political sensitivities about weaponising AI-enabled autonomy. Although it has declared that a human will always remain "in the loop" of decision-making, the approach itself is very pragmatic, and Russian open military sources focus chiefly on discussing technical and operational challenges. Meanwhile in NATO, political sensitivities about the potential development of "killer robots" significantly limit both conceptual discussions and scientific research efforts. While the application of international law with regard to military AI and robotics is very important, the Alliance must understand that it should not hamper scientific work and conceptual understanding of autonomy or prevent it from acquiring a deep knowledge about the capabilities of adversaries.

In NATO, political sensitivities about the potential development of "killer robots" significantly limit both conceptual discussions and scientific research efforts

Russian field experiments in ongoing operations with, for instance, combat unmanned land systems are a clear sign of Moscow's desire to increase military effectiveness and exploit various new technological pathways towards that objective. Although many of the tests have failed, these failures supplied the Russian military and the defence industry with extremely valuable insights that many Allies do not have at their disposal. In addition to providing opportunities for technical evaluation, field experiments are irreplaceable in understanding the operational value of such systems. Thus, NATO should consider wider use of unmanned systems—even just prototypes, and not only aerial but also ground and maritime—in wargames and exercises as extended testbeds. The experimentation cycle should become shorter and more flexible, enabling the rapid introduction of new or reconfigured solutions. The experimental use of such systems by individual Allies during NATO exercises should not be just desirable but strongly recommended and actively encouraged.

NATO should consider wider use of unmanned systems—even just prototypes, and not only aerial but also ground and maritime—in wargames and exercises as extended testbeds

Studying and understanding the operational impact and capability implications of these systems in very complex environments, in the whole spectrum of missions and tasks, requires time and effort. At the same time, the pursuit of technological perfection with little progress in producing usable capabilities—while Russia deploys less developed systems but much faster—could put the Alliance at a disadvantage. While there is still much technological uncertainty about the ways in which autonomy will evolve, it is important to have a meaningful discussion between NATO allies about what constitutes "good enough" solutions regarding these technologies and

62. Leona Alleslev, *NATO's Science and Technology: Maintaining the Edge and Enhancing Alliance Agility* (Special Report) (Brussels: Science and Technology Committee of NATO Parliamentary Assembly, 2018), 3, 16.
63. Matej Tonin, *Artificial Intelligence: Implications for NATO's Armed Forces* (Brussels: Science and Technology Committee of NATO Parliamentary Assembly, 2018), 13.

how to better motivate the armed forces experiment much more extensively with the application of autonomous systems in the field.

This inevitably brings the challenge of interoperability—both within the armed forces of individual allies and between NATO countries. The Russian military has also identified this challenge to its capability development and has been addressing it through its "autonomy agenda," but it is much more acute for an alliance of 30 nations.[64] Even without disruptive technologies, it has serious and persistent issues with maintaining interoperability. Given the extent of synchronisation and standardisation that will be required once unmanned systems with varying degrees of autonomous functions are deployed in allied operations in large numbers and in all domains, this issue will become even more acute. This is something that NATO should address seriously if it is to avoid situations in which various semi- or fully autonomous systems operated by individual allies cannot be deployed in the same battlespace because they pose a threat to each other. In 2016, the NATO Chiefs of Transformation Conference was told that "NATO requires a mind-set that demands a shift in culture" in order not to deal with interoperability as an afterthought but, rather, forestall it in the early stages of capability development.[65] This approach cannot be more relevant than in the development of unmanned AI-enabled military systems.

It is important to have a meaningful discussion between NATO allies about what constitutes "good enough" solutions regarding these technologies and how to better motivate the armed forces experiment much more extensively

In addition to addressing interoperability, the Alliance also needs to consider the implications of Russia's strong emphasis on employing AI to augment its C2 and EW capabilities. The potency of Russian EW capabilities has been acknowledged by NATO experts, and this recognition certainly must have shaped various aspects of the new NATO Electronic Warfare Doctrine put forward for ratification in the second half of 2019.[66] But it will become an even greater challenge once Russia deploys AI-enabled EW systems. NATO's capability developers will need to pursue greater synergy between the Alliance's own EW and AI development efforts in order to produce integrated solutions to the challenges posed by Russia in the electromagnetic spectrum.

Agility in the development of autonomy and robotics requires flexibility and proper risk management as well as clarity at policy level and freedom of action in experimentation and implementation

Meanwhile, in C2 development, while the level of AI technology is arguably not yet sufficient to provide comprehensive and seamless support to operational and tactical decision-making, Russia's military has been taking steps to simplify those decision-making processes and thus make it easier to apply relatively simple AI-enabled decision-support solutions. The effect will be a faster OODA cycle that will be able to surpass the speed at which the Alliance's overly complex C2 arrangements work. NATO will need to take a very thorough look at those arrangements in the context of opportunities

In addition to addressing interoperability, the Alliance also needs to consider the implications of Russia's strong emphasis on employing AI to augment its C2 and EW capabilities

64. Roman Kordyukov, "Armiya rvyetsya v tekhnologicheskiye lidery" [The Army is pushing through to the ranks of technology leaders], *Nezavisimoye voennoye obozreniye*, 19 May 2017.

65. NATO Allied Command Transformation, "Enhancing Interoperability," Syndicate Session 2, Chiefs of Transformation Conference, Norfolk (Virginia), 13–15 December 2016.

66. Malte von Spreckelsen, "Electronic Warfare – The Forgotten Discipline," *The Journal of the JAPCC* (Joint Air Power Competence Centre), Edition 27 (Autumn/Winter 2018), 43; Sydney J. Freedberg Jr., "Electronic Warfare: Better, But Still Not Good Enough," *Breaking Defense,* 1 November 2019.

and risks associated with the impact of AI. This will become even more pressing once the overall Russian approach to eventually move from only AI-enabled decision-making to an AI-orchestrated system of systems connecting multiple semi- and fully autonomous weapon systems in all operational domains (land, sea, air, outer space, cyberspace) gains traction.

NATO is a large organisation in which routine processes do not necessarily move at the speed required by rapid technological change.

The currently unfolding story behind Russia's ongoing overall military modernisation has a significant subplot of innovation to capture and harness the trends of digitisation, roboticisation and the pursuit of greater machine autonomy in the battlefield

Agility in the development of autonomy and robotics requires flexibility and proper risk management as well as clarity at policy level and freedom of action in experimentation and implementation. Early engagement between operational and scientific communities and industry plays a crucial role in advancing pragmatic yet innovative applications of AI-enabled autonomy in military capabilities, and this engagement must be provided with an effective framework in each and every nation of the Alliance.

Another key issue is the lack of synergy in efforts undertaken under the auspices of NATO and the EU. Work done through autonomy-focused projects by the nations that are members of both groups is often officially separated. These organisations should have closer, officially mandated and more visible interaction in pushing forward with their technological and capability development ambitions. Operational

Russia has already been demonstrating much improved capabilities in wars against Ukraine and in Syria which include unmanned systems and platforms that it previously lacked

knowledge that is concentrated in NATO and industry-engagement experience accumulated by the EU should be complementary to avoid parallel, resource-wasting efforts by their member states.

Conclusions

When it comes to military technology, Russia's capability development is often a story of catching up with the West in some key technology areas such as long-range conventional precision strike, while preserving its traditional strengths (e.g. in electronic warfare) or creating some asymmetric advantages (e.g. in cyberwarfare). The currently unfolding story behind Russia's ongoing overall military modernisation has a significant subplot of innovation to capture and harness the same trends of digitisation, roboticisation and the pursuit of greater machine autonomy in the battlefield that Western armed forces have also identified and, to a certain degree and with some caveats, prioritised. Russia's conceptual military thinking, long-term capability development programmes and military innovation activities assign high importance to these trends and their exploitation to produce better operational results—often within the traditional framework that emphasises mass, firepower, operational depth, speed and manoeuvrability, but also in the context of grey zone or hybrid conflicts.

Moscow's penchant for publicity stunts should not distract from the fact that it takes the prospect of roboticised future battlefields very seriously and is preparing for this, both conceptually and in practice

The gap between the Western military's high-tech advances and Russian military realities in the 2000s—the former largely driven by the challenges of military campaigns post-9/11 and the latter largely shaped by the chaos, neglect and decay of the immediate post-Soviet period—is now gradually closing.

Sharpening geopolitical competition with the West is certainly a major force in Moscow's efforts not to fall behind again in adopting such key emerging disruptive technologies as AI and robotics. Compared to its fairly dismal performance against a far less capable Georgian military in the war of 2008, Russia has already been demonstrating much improved capabilities in wars against Ukraine and in Syria which include unmanned systems and platforms that it previously lacked. While there are still significant deficiencies in what Russia can deploy (e.g. long-range UAVs), it is using those conflicts to experiment, learn and select the most promising applications in aerial, land and maritime domains. Its approach is pragmatic and flexible, while its efforts span the full spectrum of capabilities—from combat and combat support to combat service support, with a particular focus on AI-enabled network-centric capabilities that build on automation of various C2 processes. And this approach is not encumbered by the legal, ethical and moral concerns that constrain Western, especially European, developers of autonomous military technologies.

NATO has recently made some important changes in how it deals with the general issue of maintaining a technological edge

Russia's progress in this field may well be stymied by its underfunded civilian S&T sector, the inability of the defence industry to deliver, and other factors that the defence leadership is often unable to resolve through its top-down directives. Indeed, many of the examples of military robots that appear in defence exhibitions, during exercises and on the battlefield will never become actual capabilities. However, Moscow's penchant for publicity stunts should not distract from the fact that it takes the prospect of roboticised future battlefields very seriously and is preparing for this, both conceptually and in practice.

If NATO fails to mobilise and steer its intellectual, industrial, financial and other resources towards shaping the contours of the future battlespace dominated by autonomous AI-enabled military systems, there is a risk that it will face rules of the game dictated in this battlespace by hostile actors

The implications for the defence of front-line NATO allies such as Estonia is clear: these countries (and NATO as a whole) must watch Russia's military innovation and modernisation ever more closely, study the concepts that emerge from Russia's military thinking about autonomous military systems much more seriously, and adjust their own approach on how to counter Russia's hybrid and conventional operations with a significant unmanned component in all domains of warfare. Current TTPs that stand a chance of producing the desired end-state against the Russian Armed Forces of yesterday or today will not work against them ten years from now. Estonia's defence establishment will have to become much more adroit and flexible in tapping into the national and allied scientific, technological and industrial base for new solutions as well as in adapting and scaling up those solutions in developing future defence capabilities. The EDF will need to become more forward-leaning and experiment much more vigorously and rigorously with various innovative concepts that address the challenges posed by Russia's emerging autonomous military capabilities.

NATO has recently made some important changes in how it deals with the general issue of maintaining a technological edge. By approving the Emerging and Disruptive Technologies Roadmap, it sought to establish a more focused approach to combining technology development with capability development as well as creating more synergy between the Allies and multiple stakeholders in achieving and maintaining technological agility. Among those technologies prioritised in the roadmap, autonomy stands out as an extremely large field to address, comprising various technological and operational domains and capability areas. An orchestrated and invigorated approach sought by the roadmap is certainly necessary to prepare the Alliance for future challenges.

That future is not so far away. As evaluated by NATO's report "Science and Technology Trends 2020–2040," autonomous systems and AI will be a significant part of the deployed capabilities within the timeframe of five to ten years.[67] Russia is just one of the hostile actors pushing forward with the development of these systems and working to offset the technological gaps to the so far superior military capabilities of the Alliance. If NATO fails to mobilise and steer its intellectual, industrial, financial and other resources towards shaping the contours of the future battlespace dominated by autonomous AI-enabled military systems, there is a risk that it will face rules of the game dictated in this battlespace by those hostile actors.

67. NATO Science and Technology Organisation (STO), *Science and Technology Trends 2020–2040: Exploring the S&T Edge* (Brussels: NATO Science and Technology Orgnisation, Office of the Chief Scientist, 2020), vii.

Annex A. Envisaged Roles and Requirements of Land Robotic Systems in the Russian Armed Forces[68]

A.1. Roles

- Break through a deliberate enemy defence
- Support the conduct of defensive operations by tactical formations through the creation of a system of robotised firing positions in the screening zone
- Provide covering fire for advancing units and subunits and suppress enemy weapons systems
- Artillery reconnaissance and servicing the firing of ground-based artillery
- Elimination of off-nominal situations with the handling of dangerous munitions, ordnance disposal, the conduct of emergency response and restoration work at bases and arsenals and in special conditions
- Evacuation from the battlefield or from accident location of injured personnel and equipment damaged under enemy fire or in conditions of terrain contamination
- Engineer reconnaissance, minelaying, mine clearing, clearing a lane in minefields and other obstacles and supporting their negotiation
- Conduct radiological, chemical and biological reconnaissance
- Lay smokescreens in enemy fire-effect zone
- Delivery of munitions and petroleum, oil and lubricants to subunits located in the enemy fire-effect zone
- Security and defence of the position and border areas, the deployment locations of units and subunits, troop facilities, mountain passes and road intersections.

A.2. Requirements

- Compliance with the requirements for its intended purpose during the accomplishment of missions in the various conditions of a combat situation
- Potential for the employment of military robotic complexes at any time of day in conditions of enemy counter-fire and electronic and information countermeasures
- Survivability of the military robotic complex in conditions of exposure to the environment (mechanical, climatic, meteorological, radiological and chemical contamination, and electromagnetic emissions)
- Modularity (equipping with functional elements in accordance with the assigned mission)
- Multifunctionality, interoperability and the capability for integration into existing and advanced structures of the Russian Armed Forces
- Capability for self-contained, autonomous accomplishment of missions in conditions of uncertainty about the external situation (in other words, the availability of artificial intelligence)
- Standardisation of ground control stations for the processing of information based on the general principles of the integration of communications and data transmission systems with the employment of standardised data exchange protocols, hardware and software tools, and the possibility of integration into the joint troop and weapons C2 system

68. From Zyuzin, et al., "Voyuyut roboty."

- Capability for the command and control of military robotic complexes and the receipt of information from them during direct radio line of sight and with the use of relays, military and dual-use space communications systems, and also of unmanned aerial vehicles and aerostats
- Use of high-speed, broadband, jam-resistant, secure communications channels for data transmission and receipt of command and control orders
- Provision of electromagnetic compatibility and group information exchange among military robotic complexes during the accomplishment of missions in a common combat C2 area in the establishment of a composite team, including with crews of models of Weapons, Military and Special Equipment (*vooruzheniye, voyennaya i spetsial'nay tekhnika*, VVST)
- Capability for the simultaneous employment and command and control of the required number of military robotic complexes
- Provision of remote, automatic (software) and automated (with operator's control) of the command and control of a military robotic complex and its payload
- Automatic return to the starting point of a movement
- Equipping with integrated onboard navigation user equipment of GPS, GLONASS and other satellite navigation systems
- Equipping military robotic complexes with national identification "friend or foe" complexes
- Standardisation of the complexes' maintenance processes and the training of combat crews
- Presence in the complex's composition of hardware and software tools that support simulator training and the training of the combat crews' operators.

Annex B. Selected Robotic Systems Developed and/or Used by Russia

B.1 Russian UGVs

This table provides an overview of the UGVs which have either been in development or are now in use for the Russian military.[1]

NAME(S)	MANUFACTURER(S)	PURPOSE	LATEST NEWS	WEIGHT (KG)	RANGE	SPEED (KM/H)	ARMED	ARMAMENT
ARGO RBTK АРГО РБТК	Central Design Institute of Robotics and Technical Cybernetics	Fire Support (FS), Recon, Patrolling, Logistics	December 2015	1,020	?	20	Yes	7.62mm PKT machine gun, 3 RPG-26 or RshG-2 ATGM
Apparently based on the Canadian amphibious all-terrain vehicle *Argo*, this UGV was revealed in July 2013 at Rzhev test site at an MoD meeting.[2] In late 2015 Russian state media reported that *Argo* (and *Platforma*-M) was used by the Syrian Arab Army in Latakia, Syria, although subsequent reporting from independent sources has cast doubt on this claim.[3]								
KAPITAN КАПИТАН (CAPTAIN)	Izhevsk Radio Plant	Recon, Explosive Ordnance Disposal (EOD), EW	February 2021	35	500m (urban), 1km (open)	5.5	No	Although not armed, it may be in the future and might specifically incorporate weapons for EW
First unveiled in 2017 at the Army-2017 exhibition, according to state media the *Kapitan* passed field tests in 2019 and will enter service with the Russian military. [4]								
KRYMSK КРЫМСК	Military-Industrial Company	Logistics, EW	June 2016	22,000	940km	97	No	Could be armed with EW devices or weapons in the future
Based on BTR-90 *Rostok*, this remotely controlled APC was announced in July 2013 with the intention to have a hybrid engine and electrical transmission for silent, battery-driven movement.[5] While it was reported that the silent APC had completed trials in 2016 at the KADEX - Kazakhstan Defence exhibition, an unmanned robotic *Krymsk* does not appear to have entered military service yet.[6]								
KUNGAS КУНГАС	Special Engineering Design Bureau (SKBM)	Recon Combat, FS Recon, Combat, FS Combat, FS, EW, Medical, Logistics FS and Logistics	March 2020	Varies by vehicle 12 200 2,000 2,000 15,000	?	Varies by vehicle ? ? ? 11 70	Yes	Manipulator Engineering manipulator or combat module of either PKTM 7.62mm machine gun, grenade launcher, rocket-propelled infantry flamethrower, or up to 4 anti-tank missiles 12.7mm *Kord* heavy machine gun and AG-30 automatic grenade launcher Either a *Kord* 12.7mm machine gun or 7.62mm PKTM, optional AG-30 automatic grenade launcher Either a *Kord* 12.7mm machine gun or 7.62mm PKTM, optional AG-30 automatic grenade launcher
According to a Zvezda TV spotlight, *Kungas* is a combat family of UGVs consisting of: 1. "man-portable" robot, 2. "light" wheeled robot, 3. tracked air-transportable vehicle, 4. *Nerekhta* UGV, and 5. unmanned BTR-MDM *Rakushka* (Shell) APC.[7] Russian media reports that initial development was carried out by SKBM and first demonstrated in 2017. Testing continued through 2018 by Central Research Institute of MoD.[8] This UGV family was due to enter experimental military operation sometime in 2020.[9]								

1. Some UGVs were intentionally omitted from this annex due to their relatively small size, experimental status or comparatively limited combat potential as sapper robots. These include *Varyag*, *Vepr*, *Verkholaz*, *Tornado*, *Tral Patrol* 4.0, *Shatun* and *Sanitar*. For more information on these, see Oleg Falichev, "Soldaty na zakaz" [Soldiers on order], *Voyenno-promyshlennyy kur'yer*, 1 June 2015. In addition to these seven small UGVs, this annex also omits the *Sfera* (*Sphere*) and *Skarabey* (*Scarab*), which were tested in Syria in 2018 and accepted for service for Russia's engineering troops; see "Russia to accept advanced robotic mine-clearing vehicles in 2018," TASS, 22 May 2018. Furthermore, the *Scorpion* sapper robot, a successor to the *Skarabey*, was also not included; see "Russia testing new combat engineering robot based on Syrian experience," TASS, 17 July 2019. The *Scorpion* sapper robot should not be confused with the *Scorpion* patrol UGV by Promobot, which is a policing robot equipped with a projectable net; see "Rossiya 24: robot-politseyskiy 'Skorpion' pomozhet zaderzhivat' prestupnikov | Promobot" [Russia 24: "Scorpion" robot-cop will help detain criminals], *Rossiya 24*, 27 February 2020 (available on YouTube).
2. "Robotic complex RBTK," *Voyennoye obozreniye*, 5 December 2013.
3. Aric Toler, "Were Russian Combat Robots Used in Syria?," Bellingcat, 15 January 2016.
4. "Robotic engineering complex 'Captain' passed the tests," Voyennoe obozreniye, 4 July 2019.
5. "Novosti proyekta bronitransportyera s gibridnoy silovoy ustanovkoy 'Krymsk'" [News on the project for "Krymsk" armoured transporter with a hybrid power feature], *Voyennoye obozreniye*, 15 July 2016.
6. Dmitriy Sergeyev, "Besshumnyy tank na kolyesakh: rossiyskaya armiya poluchit unikal'nyy BTR na elektrodvigatelyakh" [Noiseless tank on wheels: Russian army will receive a unique armoured vehicle with electric engine], Zvezda (The *Star*), 7 June 2016.
7. "Kungas. Proverka yadernym udarom" [Kungas. Test with a nuclear strike], *Zvezda* (video), 10 November 2019.
8. "Chto za robototekhnicheskiy kompleks 'Kungas' poyavitsya u rossiyskoy armii?" [What kind of "Kungas" robotechnical complex will appear in the Russian army?], *Argumenty i fakty* (*Arguments and Facts*), 25 November 2019.
9. "Kompleks 'Kungas' postupit v opytno-voyskovuyu ekspluatatsiyu v 2020 godu" ["Kungas" complex will enter experimental field service in 2020], TASS, 24 November 2019.

MARKER МАРКЕР	Foundation for Advanced Studies and *Android tekhnika*	Recon, FS	January 2021	?	?	?	Yes	7.62mm PKT/PKTM machine gun and 2 anti-tank guided missiles. Also capable of launching small UAVs. Could be equipped with a grenade launcher module and/ or 120mm mortars in the future
With at least five UGVs in development, further field testing was performed in early 2020 including swarm tests alongside the *Kungas*.[10] An experimental, possibly amphibious, prototype was tested in July 2019, while UAV testing was held in October 2019.[11]								
MARS A-800 МАРС А-800 MOBILE AUTONOMOUS ROBOT SYSTEM A800	Design Bureau Aurora	Logistics	November 2019	950	500km	35	No	-
Capable of carrying six men or about 500kg of supplies, this UGV's testing has continued into 2019 with the Russian Airborne Forces.[12]								
MRK-27-BT МРК-27 БТ	Bauman Moscow State Technical University	Recon, Combat	June 2016	200	1km	2	Yes	*Pecheneg* machine gun, two RShG-2 grenade launchers, two *Shmel* flamethrowers, and six smoke grenades
Despite its reveal at the Interpolitex-2009 Arms Exhibition as a robot equipped for combat, there is some scepticism over its practical use in the Russian Armed Forces.[13] In addition, there are several non-combat variants of the MRK-27, such as MRK27-BU, MRK-27X, MRK-27MA and MRK-27VU. These are mostly used for reconnaissance, demining, and surveying disaster areas such as radioactive and chemically contaminated zones.[14] For example, a prototype of the MRK-27 was used during the response to the 1997 Sarov incident in Chechnya.[15]								
NAKHLEBNIK НАХЛЕБНИК (FREELOADER)	Kalashnikov	Recon, Combat, FS, Logistics, EOD	March 2020	?	?	?	Yes	Tested with four-barrelled GSHG-7.62mm machine gun. Described as a modular platform with turret options, so probably could also accommodate 7.62mm PKT machine gun
In May 2018 state media RT reported that the *Nakhlebnik* was experimental and currently not slated for military use. It was originally intended to work in tandem with the *Soratnik* UGV.[16]								
NEREKHTA НЕРЕХТА	Degtyaryov Plant and Foundation for Advanced Research Projects	Recon, Combat, Logistics	October 2017	2,000	?	11	Yes	7.62mm PTK machine gun or *Kord*-12.7mm heavy machine gun, AG-30M automatic grenade launcher; possible armament with anti-tank missiles being considered
In October 2017, Colonel Oleg Pomazuyev announced that the Russian Army was adopting the *Nerekhta*.[17] Previously, in October 2016, *Izvestiya* reported that Russian intelligence and special forces were expected to receive it.[18]								
PALADIN ПАЛАДИН	All-Russian Research Institute "Signal"	Combat, FS, Logistics	June 2019	18,700	?	70	Yes	Two 100mm and 30mm calibre guns alongside a 7.62mm PKT machine gun
Built on the BMP-3 *Dragoon chassis*, the remotely controlled *Paladin* was first revealed in 2019 at the International Military-Technical Army Forum 2019.[19]								
PLATFORMA-M ПЛАТФОРМА-М (PLATFORM-M)	Izhmash-Unmanned Systems and NITI "Progress" Science and Technical Institute	Combat, Recon, FS, Mining, Demining, Logistics, Patrolling	December 2015	800	1.5km	12	Yes	7.62mm PKT machine gun and 4 grenade launchers
State-backed media Russia Beyond (RBTH) first reported that *Platforma*-M participated in the June 2014 military exercises in Kaliningrad with the Baltic Fleet.[20] This UGV was publicly seen at the 2015 Victory Day Parade in Kaliningrad.[21] Special Forces in the Central Military District reportedly received it in 2016.[22] Russian state-media reported that *Platforma*-M (and Argo RBTK) were used by the Syrian Arab Army in Latakia, Syria, although subsequent reporting has cast doubt on this claim.[23]								
PROKHOD-1 ПРОХОД-1 (PASSAGE)	All-Russian Research Institute "Signal"	Demining	November 2017	45,000	?	30–50	Yes	*Kord*-12.7mm heavy machine gun, 4 smoke grenades, and a TMT-S trawl
Based on the BMR-3MA armoured vehicle, which uses the T-90 tank chassis and designed for demining purposes, state media reported that *Prokhod* completed state tests in July 2016 and was featured on *Zvezda* TV in 2017.[24]								

10. Kelsey D. Atherton, "Russia will test swarms for anti-robot combat in 2020," C4ISRNET, 13 December 2019.
11. Melanie Rovery, "Russia reveals its updated Marker UGV," *Jane's*, 17 December 2019.
12. Nikolai Novichkov, "Army 2019: Russian VDV trials Mars A-800 UGV," *Jane's*, 30 June 2019.
13. Dmitry Litovkin, "Russian army to replace soldiers with robots," *Russia Beyond*, 8 January 2013.
14. "MRK-27 - mobile robotic complex for power structures," *Voyennoye obozreniye*, 22 June 2016.
15. International Atomic Energy Agency, *The Criticality Accident in Sarov* (Vienna: IAEA, 2001), 14–15.
16. "Race of the war machines: Russian battlefield robots rise to the challenge," RT, 5 May 2018.
17. "Boyevogo robota 'Nerekhta' primut na vooruzheniye rossiyskoy armii" ["Nerekhta" combat robot will be accepted into Russian army weaponry], Interfax, 30 October 2017.
18. Aleksey Moiseyev, "Dlya rossiyskogo spettsnaza razrabotali robota-kamikadze" [Kamikaze robot developed for Russian special forces], *Izvestiya*, 3 October 2016.
19. "Rostekh vpervye predstavit boyevoy robototekhnicheskiy kompleks 'Paladin'" [Rostec will present combat robotechnical complex 'Paladin' for the first time], Rostec, 24 June 2019. Because Rostec's press release was short on details, *Paladin* specifications are estimated based on the BMP-3.
20. Alexánder Korolkov, "Platform-M combat robot introduced at Kaliningrad military exercises," *Russia Beyond*, 3 July 2014.
21. Oleg Makarov, "Rossiyskiye boyevye roboty 'Platforma-M' i 'Uran-9': test-drayv" [Test drives: Russian combat robots "Platforma-M" and "Uran-9"], *Populyarnaya mekhanika* (*Popular Mechanics*), 5 August 2016.
22. "Na vooruzheniye spetsnaza TsVO postupili pervye distantsionno upravlyayemye roboty 'Platforma-M'" [First "Platforma-M" remote-controlled robots entered armaments of the special forces of the Central Military District], TASS, 30 January 2016.
23. Toler, "Were Russian Combat Robots Used in Syria?".
24. For completion of state tests, see "Novyy robot-saper 'Prokhod-1' zavershil gosispytaniya" [New "Prokhod-1" robot sapper passed state tests], TASS, 15 July 2016. For *Zvezda* state TV feature, see "'Prokhod'. Robot-saper v tankovoy brone" ["Prokhod" robot deminer in tank's armour], Zvezda (video), 12 November 2017.

SHTURM ШТУРМ (ASSAULT)	Uralvagonozavod	Combat	December 2020	46,000	?	70	Yes	4 variants all equipped with dozer blade, 7.62mm PKT machine gun, and active protection. 125mm cannon with truncated barrel *Shmel*-M rockets Turret mounting two 2A42 30mm cannon 16 NURS 220mm thermobaric rockets
Concept consisting of four vehicle types based on T-72B3 tank hull, *Shturm* plans for Russian MoD R&D were announced in December 2019.[25]								
SORATNIK BAS-01G BM СОРАТНИК (COMPANION)	Kalashnikov	Recon, FS, Patrol, Logistics	December 2020	7,000	400km	40	Yes	7.62mm PKT/PKTM machine gun; *Kord*-12.7mm heavy machine gun; 30mm AG-17A *Plamya* automatic grenade launcher and a 40mm 6G27 *Balkan* AGL. This UGV can accommodate up to four hand grenade launchers and includes possible armament with 8 *Kornet*-EM anti-tank missiles
Allegedly tested in "near-combat conditions" in Syria in around January 2018.[26] Russian MoD to develop new line-up of UGVs based on *Soratnik*, although the Soratnik was not initially slated for military use.[27]								
STRELOK СТРЕЛОК (SHOOTER)	Special Construction Machinery Ltd.	Recon, Patrol, Combat	January 2013	450	5–20km	4	Yes	7.62mm PKM machine gun
Shown only at the 2013 Russian Arms Exhibition, this UGV is a small robot intended for counterterrorism operations and urban environments.[28] It has not made an appearance since then.								
URAN-6 УРАН-6 (URANUS-6) **MRTK-R** МРТК-Р	JSC 766 UPTK	Demining	December 2020	5,000–6,000	1.5–3km	5	No	1.8m-wide bulldozer blade, self-propelled *Boikova* mine-sweeper, robotic arm, solid milling, tiller, trailer, crane, tong-type gripper with a cargo lifting capacity of 1,000kg, and solid roller and *Katkov* demining trawl
The *Uran*-6 was used to clear mines in Chechnya and Ingushetia in 2016, in Palmyra, Syria in 2016, in Aleppo, Syria in 2017, and in Dei ez-Zor, Syria in September 2017.[29] Created alongside the *Uran*-9 as part of the *Dolomit* (*Dolomite*) project.[30] In 2019, the Russian MoD announced it was acquiring 12 additional *Uran*-6 UGVs.[31]								
URAN-9 УРАН-9 (URANUS-9)	JSC 766 UPTK	Recon, Combat, FS	December 2020	10,000	?	35	Yes	9M120-1 *Ataka* anti-tank guided missile launchers; 30mm 2A72 automatic cannon with PKT/PKTM 7.62mm coaxial machine gun; rocket-propelled *Shmel*-M reactive flamethrower; and/or *Igla* or Verba surface-to-air missiles and 9M133M *Kornet*-M anti-tank guided missiles
The *Uran*-9 was adopted by the Russian army in 2019.[32] The UGV entered service despite encountering serious deficiencies when testing in Syria in 2018.[33] Created alongside the *Uran*-6 as part of the *Dolomit* (*Dolomite*) project.[34]								
URAN-14 УРАН-14 (URANUS-14) **MRTK-P** МРТК- П	JSC 766 UPTK	Firefighting	August 2019	14,000	?	12	No	-
Not to be confused with the *Uran*-6 and *Uran*-9, this UGV is not used for combat but for extinguishing life-threatening fires, such as high-temperature fires at military depots or petrochemicals facilities.[35] In August 2019, a pair of *Uran*-14s were deployed to help extinguish an ammunition depot fire in Siberia.[36]								
URP-01G УРП-01Г	United Instrument-Making Corporation	Recon, Combat, Demining, Patrolling, Policing	May 2015	?	10km	40	Yes	Unclear. Reportedly "large-calibre machine guns" and "grenade launched compartment"
Development reported in 2015 but it is not possible to locate any recent developments. Intended for use in the Arctic.[37]								

25. Tamir Eshel, "Robotized T-72s in Russia," Defense Update, 9 December 2018.
26. "Russia tests robotic strike vehicle in conditions close to real combat," TASS, 19 January 2018.
27. Kelsey D. Atherton, "Russia eager to prove recent conflicts improved its robots," C4ISRNET, 27 June 2019.
28. "Robot-pulemet 'Strelok' stanet grozoy terroristov" ["Strelok" robot machine gun will be a menace to terrorists], *Vestnik Mordovii* (*Mes*senger of Mordovia), 10 January 2013.
29. "Sapery v Chechne i Ingushetii razminirovali svyshe 10 tys. ga. sel'khozugodiy" [Deminers in Chechnya and Ingushetia demined more than 10,000 hectares of agricultural land], Interfax, 2 January 2016; Vladimir Isachenkov, "Russian sappers with robots to clear mines in Palmyra," Associated Press, 31 March 2016; "Otryad rossiyskikh saperov v Aleppo usilyat robotami 'Uran-6'" [Platoon of Russian sappers in Aleppo will be reinforced by "Uran-6" robots], Interfax, 3 December 2016; "Russian sappers arrive in Syria's Deir ez-Zor," TASS, 11 September 2017.
30. "Rossiyskiye voyennye poluchat v 2019 godu 12 robotov-saperov" [Russian military will receive 12 robots-sappers in 2019], Interfax, 2 January 2019.
31. Kelsey D. Atherton, "Russia orders a dozen new demining robots," C4ISRNET, 4 February 2019.
32. "Boyevoy robot 'Uran-9' postupil na vooruzheniye Rossiyskoy armii" ["Uran-9" combat robot has entered service in the Russian army], *Izvestiya*, 24 January 2019.
33. Dylan Malyasov, "Combat tests in Syria brought to light deficiencies of Russian unmanned mini-tank," *Defence Blog*, 18 June 2018.
34. "Rossiyskiye voyennye poluchat v 2019 godu 12 robotov-saperov," Interfax.
35. Aleksandr Grigoryev, "Bronemonstry spetsial'nogo naznacheniya protiv razbushevavsheysya stikhii" [Armoured special-purpose monsters against raging elements], *Yezhenedel'nik 'Zvezda'* (*The Star Weekly*), 28 August 2019.
36. Joseph Trevithick, "Russian Ammo Depot Has Been Burning for Hours After Exploding in Giant Shockwave," *The Drive*, 5 August 2019.
37. "Russia to develop tracked modular robot for combat, Arctic expeditions," TASS, 15 May 2015.

VIKHR / UDAR ВИХРЬ / УДАР (VORTEX / BLOW)	Sevastopol Scientific and Technical Centre "Impulse-2" and the All-Russian Research Institute "Signal"	Recon, Combat	February 2021	14,700	600km	60	Yes	30mm 2A72 automatic cannon, coaxial 7.62mm PKTM machine gun and six 9M133M *Kornet*-M guided anti-tank missiles (AT-14 *Spriggan*); fitted with UAV quadcopters
The *Vikhr* and *Udar* are augmented BMP-3 IFVs with small UAVs developed in coordination with Russian MoD R&D, first unveiled in 2016.[38] In 2021, Rostec official Bekkhan Ozdoyev told TASS that *Udar* would be capable of moving on the battlefield autonomously and interacting with drones.[39]								
VOLK-2 ВОЛК-2 (WOLF-2) **MRK-002-BG-57** МРК-002-БГ-57	Izhevsk Radio Plant	Recon, Patrolling, FS	November 2016	980	5km	45	Yes	7.62mm or 12.7mm machine gun or 30mm grenade launcher
Reportedly successfully tested by the Strategic Missile Forces as a remote sentry UGV to guard RS-24 *Yars* and RT-2PM2 *Topol* missile sites and used alongside *Tayfun*-M (*Typhoon*-M) in 2016, an APC-based vehicle equipped with an *Eleron*-3SV UAV.[40]								

38. Nikolai Novichkov, "New Russian Combat UGV Breaks Cover," *Jane's*, 9 September 2016.
39. "Russia's latest Udar robot to learn to fight on its own and interact with drones," TASS, 11 February 2021.
40. Rafał Muczyński, "Ochrona Anty-Sabotażowa Rosyjskich Wojsk Rakietowych Strategicznego Przeznaczenia" [Counter-sabotage protection of the Russian Strategic Missile Forces], NOWA, 22 November 2016.

B.2 Russian UAVs

Russia has stationed UAVs (*Orlan*-10, *Leyer*-3, *Eleron*, *Granat* and *Takhion*) at military bases in Tajikistan and Armenia.[41]

NAME(S)[42]	ORIGIN	MANUFACTURER(S)	TYPE	CLASS	CATEGORY[43]	OPERATOR	PURPOSE	FLIGHT TIME	MTOW kg	MAX ALTITUDE km	CRUISING SPEED km/h	MAX SPEED km/h	RANGE km	ARMED[44]
ACTIVE														
ELERON-3SV ЭЛЕРОН-3СV (AILERON-3SV)	Russia	ENICS	Fixed Wing	I	Mini	Army	ISR	2 hours	5.3	5	80– 110	130	120–600	No
Introduced into the Russian military in 2013, the *Eleron*-3SV is a special-purpose short-range reconnaissance system which has operated in both Syria and Ukraine.[45] In July 2015 an *Eleron*-3SV was reported to have been shot down by al-Nusra over Latakia, Syria.[46] In July 2019, Ukrainian special forces reportedly shot down an *Eleron*-3SV over the Donbas in the Svitlodarska Duha bulge area.[47] In 2016, it was reported that Russia deployed *Eleron*-3s to the Kuril Islands, claimed by Japan.[48] Moreover, the *Tayfun*-M (*Typhoon*-M) armoured vehicle comes with at least one *Eleron*-3SV for surveillance and reconnaissance.[49]														
ELERON-10SV ЭЛЕРОН-10СV (AILERON-10SV)	Russia	ENICS	Fixed Wing	I	Mini	Army	ISR	2.5 hours	15.5	4	90	135	60	No
The *Eleron*-10 reportedly passed flight tests and entered service with the Russian Armed Forces sometime during 2008.[50]														
FORPOST-R IAI SEARCHER MK II ФОРПОСТ-Р (OUTPOST-R)	Israel	Ural Civil Aviation Plant (UZGA)	Fixed Wing	II	Tactical	Navy, Army, Air Force	ISR	16–18 hours	500	6	130	200	250	No
In 2009, the Russian MoD signed a $53-million contract with Israel Aerospace Industries (IAI) for the purchase of 12 IAI *Searcher* II reconnaissance UAVs, delivered in 2011. In 2010, Russia signed a $400-million contract for a Russian-licensed *Searcher* II enabling the domestic production of the *Forpost* UAV based on the Israeli model. Independent Russian news reported in 2015 that the Russian MoD had purchased an additional ten Israeli IAI *Searcher* II reconnaissance UAVs. At least five *Forpost* UAVs have been downed in eastern Ukraine.[51] *Forpost* drones have also been used in Syria. Initial *Forpost* UAV deployments centred around Khmeimim Air Base in Latakia, but they were later spotted at Aleppo International Airport in 2016, Deir ez-Zor Airport in 2017 and T-4 Air Base in 2019.[52] In 2016, the US intervened and pressured Israel to end the sale of its UAVs to Russia.[53] Russian state media reported in August 2019 that the Black Sea Fleet in Crimea was equipped with a squadron of *Forpost*.[54] In December 2019, the Russian Army ordered ten more *Forpost* UAVs to be produced and disclosed plans to acquire an additional 18 in 2020.[55]														
GRANAT-1 ГРАНАТ-1 (GARNET-1)[56]	Russia	Kalashnikov	Fixed Wing	I	Small	Army	ISR	1.3 hours	2.4	3.5– 4	60	75	15	No
The *Granat*-1 has operated in Ukraine since 2014.[57] It is part of the *Navodchik*-2 UAV complex, primarily designed to direct artillery fire.[58] Reconnaissance units at the Russian 102nd Military Base in Armenia were equipped with *Navodchik*-2s (alongside *Orlan*-10s) in 2015.[59]														
GRANAT-2 ГРАНАТ-2 (GARNET-2)	Russia	Kalashnikov	Fixed Wing	I	Small	Army	ISR	1.5 hours	4	4.1	70	85	15	No
In January 2019, Ukrainian Joint Forces Operation reported that Ukrainian servicemen captured a *Granat*-2 UAV in Eastern Ukraine.[60]														

41. "Five advanced drones arrive for Russia's military base in Tajikistan," TASS, 13 March 2019.
42. This annex, while comprehensive, omits a number of UAVs due to limited information regarding their ongoing development and use or apparent lack of operation in the Russian military. For an extended list of Russian UAVs undergoing research and development, see Timothy L. Thomas, *Russia Military Strategy: Impacting the 21st Century Reform and Geopolitics* (Fort Leavenworth, KS: Foreign Military Studies Office, 2015), 136–142; and Rob O'Gorman & Chris Abbott, *Remote control war: Unmanned combat air vehicles in China, India, Iran, Israel, Russia and Turkey* (London: Open Briefing, 2013), 47–54. Moreover, this annex intentionally omits Russian self-propelled artillery. For more information, see Andrew Radin et al., *The Future of the Russian Military: Russia's Ground Combat Capabilities and Implications for U.S.-Russia Competition* (Santa Monica, CA: RAND, 2019), 96. This annex also omits the ARKADAK-ANPA (АРКАДАК-АНПА), a reported rotary wing UAV, of which little is known other than it is in development and intended to launch from the ARKADAK-BEC unmanned aquatic vehicle/boat. See "Korvety-nevedimki usilyat otryadami morskikh dronov" [Invisible corvettes will be reinforced by squads of maritime drones], *Izvestiya*, 8 March 2018.
43. Category defined using Róbert Szabolcsi, "UAV operator training – beyond minimum standards," in *Scientific Research and Education in the Air Force*, AFASES (Romania), 2016.
44. In many cases, even drones designed primarily for reconnaissance can be retrofitted with explosives. Ukraine has attributed Russian UAVs retrofitted with thermite grenades as responsible for setting off massive explosions at ammunitions depots in Kalynivka and Balakliya. See Tony Wesolowsky, "Ukraine's Exploding Munition Depots Give Ammunition to Security Concerns," Radio Free Europe, 6 October 2017.
45. Dan Gettinger, *The Drone Databook* (Annandale-on-Hudson, NY: Bard College Center for the Study of the Drone, 2019), 64, 69.
46. Dylan Malyasov, "Russian 'Eleron-3SV' UAV lost over Syria," *Defence Blog*, 21 July 2015.
47. "UNIAN: Ukraine forces in Donbas shoot down another Russian drone," *Kyiv Post*, 12 July 2019.
48. Agence France-Presse, "Russia to Deploy Missile Systems on Kuril Islands, Defense Minister Says," *Defense News*, 25 March 2016.
49. Joseph Trevithick, "Russia's 'Counter-Sabotage Vehicle' Guards the Country's Mobile ICBMs," *The Drive*, 18 May 2017.
50. "Eleron-10. Tekhnicheskiye kharakteristiki. Foto" [Eleron-10: Technical characteristics. Photo], AVIA.PRO, 9 September 2016.
51. "Five Downed Russian Drones in Ukraine," Digital Forensic Research Lab, Atlantic Council (via Medium.com), 6 January 2017.
52. Gettinger, *The Drone Databook*, 69.
53. Arie Egozi, "Israel steps back from fresh UAV deals with Russia," *Flight Gobal*, 15 April 2016.
54. Alexey Kozachenko, Roman Kretsul & Alexey Ramm, "Prismotryat svysoka: Krym ukrepyat eskadri'ey BPLA 'Forpost'" [Will see from above: Crimea will be reinforced by a squadron of "Forpost" UAVs], *Izvestiya*, 14 August 2019.
55. "Minoborony podpisalo kontrakt na 10 bespilotnikov 'Forpost-R'" [Mindef signed a contract for 10 "Forpost-R" unmanned aerial vehicles], TASS, 5 February 2020.
56. Often also translated from Russian as "pomegranate."
57. Permanent Mission of Ukraine to the International Organizations in Vienna, "Statement by the Delegation of Ukraine at the 822nd FSC Plenary Meeting," FSC, DEL/112/16, Hofburg, 8 June 2016.
58. Michael Sheldon, "#MinskMonitor: The Russian Drone Wagons of the Donbas," Digital Forensic Research Lab, Atlantic Council (via Medium), 12 November 2018.
59. "Russia tests new stealth drones at Armenian military base," TASS, 15 December 2015.
60. Dylan Malyasov, "Russian Granat-2 unmanned aircraft shot down in Ukraine," Defence *Blog*, 25 January 2019.

GRANAT-3 ГРАНАТ-3 (GARNET-3)	Russia	Kalashnikov	Fixed Wing	I	Small	Army	ISR	2 hours	7	2	100	120	25	No
The *Granat*-3 is reportedly in use in the Russian Armed Forces.[61]														
GRANAT-4 ГРАНАТ-4 (GARNET-4)	Russia	Kalashnikov	Fixed Wing	I	Small	Army	ISR	6 hours	30	3	90	145	70	No
The *Granat*-4 has been employed in both Syria and Ukraine. In November 2014, a *Granat*-4 was shot down near Schastya in Luhansk Oblast.[62] In January 2017, Islamic State claimed to have shot down a *Granat*-4 outside Tiyas Military Air Base in Homs Governorate, Syria.[63] In March 2018, it was reported that a *Granat*-4 crashed above the town of Bosra in Syria.[64]														
LASTOCHKA ЛАСТОЧКА (SWALLOW)	Russia	Kalashnikov	Fixed Wing	I	Micro		ISR	2 hours	4.2	3.6	70	120	50	No
ORLAN-3 ОРЛАН-3 (SEA EAGLE-3)	Russia	Special Technology Center LLC	Fixed Wing	I	Mini	Army	ISR	2 hours	7	7	70– 130	150	100	No
The *Orlan*-3 passed state tests in 2011 along with the *Orlan*-10.[65]														
ORLAN-10 ОРЛАН-10 (SEA EAGLE-10)	Russia	Special Technology Center LLC	Fixed Wing	I	Small	Navy, Army, Air-borne	EW, ISR	16 hours	15– 16.5	5	110	150	70– 150	Yes?
The *Orlan*-10 is one of the most common Russian UAVs and has been used in both Ukraine and Syria.[66] Ukrainian officials have claimed to have shot down or captured at least ten *Orlan*-10s in Ukraine.[67] *Orlan*-10s are a component of the *Leer*-3 EW system consisting of three *Orlan*-10s and a *KamAZ*-5350 truck that acts as the command and control post. The *Leer*-3 has been employed in Ukraine.[68] *Orlan*-10s have been used in conflicts outside Russia, including in Libya.[69] Most recently, in March 2020, five soldiers from the Russian 61st Naval Infantry Brigade were injured when approaching a crashed *Orlan*-10 in the Pechenga Valley, Murmansk, when an explosive it was carrying detonated, indicating potential testing of *Orlan*-10s with explosive payloads. The incident happened soon after February training exercises using the *Orlan*-10 over the Kola Peninsula and coastal areas of the Barents Sea.[70] Some expert observers have considered the possibility that the *Orlan*-10 may be replaced by the *Feniks* drone.[71] In January 2021, the Russian MoD announced that it will deliver an unspecified number of *Orlan*-10E UAVs to Myanmar as part of a larger arms sales deal.[72] This will be the first time Russia enters international UAV market with its own product.[73]														
ORLAN-30 ОРЛАН-30 (SEA EAGLE-30)	Russia	Special Technology Center LLC	Fixed Wing	I	Small	Army	EW, ISR	5 hours	27	4.5	80– 150	170	300	No
State media reports that the *Orlan*-30 is twice the mass of the *Orlan*-10 and passed testing in both Syria and during the military exercise *Tsentr* (Centre) 2019. It is expected to work closely with heavy artillery. The *Orlan*-30 was due to enter Russian military service in 2020.[74]														
PCHELA-1T ПЧЕЛА-1Т (BUMBLEBEE-1T)	Russia	Yakovlev Design Bureau	Fixed Wing	I	Small	Army	ISR	3.5 hours	138	11.5	120	180	60	No
An early modern Russian UAV that saw use in the mid-1980s and during the first Chechen War in the 1990s, the *Pchela*'s poor performance during the 2008 Russo-Georgian War (unintelligible image quality, flying "so low you could hit it with a slingshot" and operating so loudly that the "[it] roared like a BTR") is credited with being another motivating factor behind Russia's decision to modernise its UAV inventory.[75] The *Pchela*-1T is a successor to an earlier, visually identical UAV, the *Shmel*-1. There are also some unverified reports from 2015 of the *Pchela* operating in Idlib, Syria.[76]														
PHANTOM-4	China	DJI	Rotary Wing	I	Micro	Army	ISR	25 minutes	1.2	4– 5	35– 56	72	6.8	No
The *Phantom*-4 is a commercially available multirotor UAV which has reportedly been identified as operating in Ukraine by Russian separatist forces.[77]														
PTERO-G0 ПТЕРО-G0	Russia	AFM Servers	Fixed Wing	I	Small	-	ISR	8 hours	20	2.5	85– 125	?	800	No
The *Ptero*-G0 is operated by Russian law enforcement and customers in Asia and the South Caucasus (known as X-55 or Kh-5).[78] It was reportedly sighted in 2016, when photos were posted of a crashed *Ptero* in Latakia, Syria. However, the UAV is not officially in service with the Russian military.[79]														

61. "Pomegranate-3. Specifications. A photo," AVIA.PRO, 10 April 2017.
62. Michael Sheldon, "#MinskMonitor: Russian Drones Directed Separatist Artillery Against Ukraine," Digital Forensic Research Lab, Atlantic Council (via Medium), 30 July 2018.
63. Dylan Malyasov, "ISIS claims to have shot down Russian Granat-4 unmanned aerial vehicle," *Defence Blog*, 25 January 2017.
64. Dylan Malyasov, "Russian drone carrying COMINT payload crashed in Syria," Defence *Blog*, 28 March 2018.
65. "OOO 'Spetsial'nyy Tekhnologicheskiy Tsentr' provodit dorobotku 'Orlan-3'" [Special Technology Centre Ltd conducts additional development of "Orlan-3"], RUVSA, 1 April 2011.
66. Anton Lavrov, "Russian UAVs in Syria," *Moscow Defense Brief*, 60 (4), 2017.
67. David Oliver, "Russia's Rapid UAV Expansion," *Armada International*, 22 March 2019.
68. "#MinskMonitor: New Russian Electronic Warfare Systems in Eastern Ukraine," Digital Forensic Research Lab, Atlantic Council (via Medium), 23 August 2018.
69. Jeremy Binnie, "Russian UAV recovered in Libya," *Jane's*, 30 April 2019.
70. Atle Staalesen, "Weapon drone crashes, explodes near Russian special forces base," *The Barents Observer*, 5 March 2020.
71. Kelsey D. Atherton, "Will Russia replace Orlan orbits with Feniks Flocks?," C4ISRNET, 10 September 2019.
72. Ministry of Defence of the Russian Federation, "Rossiya postavit M'yanme zenitnye raketno-pushechnyye kompleksy 'Pantsir-S1', bespilotnyye letatel'nyye apparaty 'Orlan-10E' i radiolokatsionnyye stantsii" [Russia will deliver to Myanmar anti-aircraft rocket-artillery complexes "Pantsir-S1", unmanned aerial vehicles "Orlan-10E" and air surveillance stations], 22 January 2021.
73. David Humbling, "Russia Enters Military Drone Export Market with Sale to Myanmar," *Forbes*, 25 January 2021.
74. Alexey Ramm and Bogdan Stepova, "Dron – v stroy: 'Orlan-30' naydet tseli dlya artillerii" [Drone to the ranks: "Orlan-30" will find targets for artillery], *Izvestiya*, 2 October 2019.
75. Tor Bukvoll, "Russia's Military Performance in Georgia," *Military Review*, November–December 2009, 60.
76. Dan Gettinger, "Drones Operating in Syria and Iraq," Field Guide, Center for the Study of the Drone, December 2016, 10.
77. "Ukrainian soldiers shot down militants' drone in Yasynuvata direction. Video," *Censor.net*, 11 May 2017.
78. Dylan Malyasov, "Azerbaijan claims its air defences shot down Armenia's tactical UAV," *Defense B*log, 15 March 2018.
79. Gettinger, "Drones Operating in Syria and Iraq," no. 11; Lavrov, "Russian UAVs in Syria."

TAKHION ТАХИОН (TACHYON)	Russia	Izhmash-UAV	Fixed Wing	I	Mini	Navy, Army, Air-borne	ISR	2 hours	25	4	65	120	40	No
Launched in 2012, this UAV is frequently deployed to military units, with units in the Eastern Military District first receiving it in 2014.[80] The *Takhion* was used against Ukraine as early as 2014.[81] Since then, *Takhion* UAVs have been used for surveillance over the Northern Sea Route and in the Arctic, as well as in the Central and Western Military Districts. [82]														
TIPCHAK ТИПЧАК	Russia	Design Bureau LUTCH	Fixed Wing				ISR	8 hours		4		125	120	No
ZASTAVA ЗАСТАВА (OUTPOST)	Israel	Ural Plant of Civil Aviation (UZGA)	Fixed Wing	I	Mini	Army	ISR	50–59 min	5.6	0.304	59– 74	83	10	No
Active in Russia since 2013, the *Zastava* was originally manufactured by Israel Aerospace Industries (IAI) under the name *Bird Eye* 400. Limited production of the *Bird Eye* 400 was assumed by UZGA under the name *Zastava*. In 2016, the US intervened and pressured Israel to end the sale of UAVs to Russia.[83] The *Zastava* has reportedly operated in the ongoing conflict in Ukraine. For example, in June 2014 and July 2015, *Zastava* drones were shot down on Ukrainian territory by Ukrainian border guards.[84]														
IN DEVELOPMENT														
ALTIUS-U ALTIUS-M ALTIUS-O АЛЬТИУС ALTAIR АЛЬТАИР	Russia	Ural Plant of Civil Aviation (UZGA)	Fixed Wing	III	MALE	-	ISR, Combat?	24 hours	6,000	12	150–250	?	10,000	No?
Design originally started under the Simonov Design Bureau (SDB) in 2011 for high-altitude surveillance. However, cost overruns and delays resulted in the project being transferred to UZGA in 2018. (In addition, the chief designer of the project at SDB was arrested and charged with "abuse of authority, misappropriation of budgetary funds and fraud.") The UAV was labelled first a strike UAV, then a reconnaissance-strike UAV, and now simply an ISR UAV.[85] The first *Altius*, called *Altair*, was unveiled in 2014, with test flights in 2016. Its successor, the *Altius*-M, was developed in 2017. The *Altius*-U is the latest and possibly final version of the project and is comparable to the MQ-9 *Reaper*. On 20 August 2019, the Russian MoD released a video of the *Altius* operating in fully automatic mode, flying for 32 minutes at 800 metres.[86]														
KARNIVORA КАРНИВОРА	Russia	NPP Mikran	Fixed Wing	I	Small	-	ISR, Combat	10–15 hours	40	?	?	150	?	Yes
Revealed in December 2018 and displayed at the Russian MoD "Robotization of the Armed Forces" conference and expo, this UAV is apparently designed to disable other UAVs using strike weapons (frag grenades, small-calibre anti-tank bombs or net guns) and nets and to operate without satellite navigation.[87]														
CHIROK ЧИРОК (TEAL)	Russia	Moscow Radio Engineering Research Institute and United Instrument-Making Corporation	Fixed Wing	III	MALE	-	ISR, EW, Combat	?	750	6	?	?	2,500	Yes?
Demonstrated in 2014 and later showcased at MAKS-2015, the primary feature of the *Chirok* UAV is an air-cushioned chassis to enable amphibious take-off. Its current status is not clear, as the most recent statements indicate that flight tests and production were intended for 2016.[88] No apparent updates since then.														
DOZOR-50 ДОЗОР-50 (PATROL-50)	Russia	Kronstadt Group (formerly Tranzas)	Fixed Wing											
DOZOR-100 ДОЗОР-100 (PATROL-100)	Russia	Kronstadt Group (formerly Tranzas)	Fixed Wing			-	ISR	10 hours	110	4– 5		120–150	120	No
DOZOR-600 DOZOR-3 ДОЗОР-600 (PATROL-600)	Russia	Kronstadt Group (formerly Tranzas)	Fixed Wing	III	MALE	-	ISR	24 hours	720	7.5		130–210	3,700	Yes
Despite development of this UAV beginning in 2005, 16 years later the *Dozor* still appears to be stuck in development limbo. The *Dozor*-600 belongs to a family of drones including the *Dozor*-100 and *Dozor*-50. First unveiled to the public at the MAKS-2009 air show as a competitor to the US MQ-1B *Predator* UAV, initial flight tests were anticipated for 2010.[89] In 2013, defence minister Sergei Shoigu ordered work to be expedited in the lead-up to a new first flight, then approximately set for 2015.[90] Since 2013, no news of the project has been released and there is no indication that these UAVs have been accepted into the armed forces. The status of the project is therefore not clear.														

80. "Small unmanned aerial vehicle 'Tachyon'," *Weapon News*, 28 November 2017.
81. "Ukrainian Gunner Shot Down a Russian Drone: 'It May have Saved Someone's Life'," *Censor.net*, 1 July 2014.
82. On the Arctic, see Isabelle Falcon, "A Perspective on Russia – Proliferated Drones," CNAS, 2016. Reported examples of *Takhions* in use include at the 201st Russian Military Base (see Gettinger, *The Drone Databook*, 66), and at training grounds in the Western Military District (see Russian Ministry of Defence, "Reconnaissance units of Western Military District hold a number of special exercises to operate behind the enemy's lines," 3 September 2018).
83. Egozi, "Israel steps back."
84. "Ukraine shot down 2 million worth Russian drone 'Zastava' aka Israel Bird Eye 400 UAV," *Lugansk News Today*, 23 July 2015.
85. Kyle Mizokami, "Russia's New 'Altair' Spy Drone Takes to the Skies," *Popular Mechanics*, 22 August 2019.
86. Stefano D'Urso, "Russian Altius-U Unmanned Aerial Vehicle flies for the first time," *The Aviationist*, 24 August 2019.
87. "V Rossii na ispytaniyah primenili oruzhiye s udarnogo bespilotnika-perekhvatchika 'Karnivora'" [Weapons from "Karnivor" unmanned aerial strike vehicle-fighter were employed during exercises in Russia], TASS, 28 January 2019.
88. "Flying bird: Russia's amphibious Chirok prototype debuts at MAKS-2015 air show," RT, 25 August 2015.
89. "Na MAKS-2009 vpervye predstavlen udarnyy bespilotnik 'Dozor-600'" ["Dozor-600" unmanned aerial strike vehicle presented for the first time at MAKS-2009], RIA Novosti, 23 August 2009.
90. Vladimir Tuchkov, "Dognat' Ameriku ne poluchayetsya: Chto meshayet russkim BPLA?" [Catching up with America is not succeeding: What is standing in the way of Russian UAVs?], *Svobodnaya pressa* (*Free Press*), 10 March 2018.

E08M BERTA БЕРТА (BERTHA)	Russia	ENICS	Fixed wing	I	Small	-	ISR, Targeting	30 minutes	170	3– 4	<280	250–280	70–150	No
The *Berta* typically operates as a target drone for training and air defence testing, much like ENICS's E95 UAV; but, unlike the E95, the *Berta* has been described as capable of acting as a reconnaissance UAV. A version with turbofan propulsion was displayed at MAKS-2019.[91]														
FENIKS ФЕНИКС (PHOENIX)	Russia	Technologies of Automation and Programming (TAIP)	Fixed Wing	I	Small	-	ISR	?	?	?	?	?	?	No
This UAV was revealed at MAKS-2019 and may be a future possible replacement for the *Orlan*-10, as it appears to be slightly more reliable and can carry a heavier payload.[92]														
FREGAT ФРЕГАТ (FRIGATE)	Russia	Kronstadt Group	Fixed / Rotary Wing	III	?	-	ISR	10 hours	1,000–1,700	8	<600	600	5	?
First unveiled to the public at MAKS-2015, the *Fregat* UAV is being developed to achieve both vertical and horizontal take-off. So far only a model of the UAV has been publicly accomplished, with plans to have a two-tonne version finished by 2020 and a seven-tonne version by 2023.[93]														
GONSHCHIK ГОНЩИК (RACER)	Russia	RSK MiG	Fixed Wing	?	?	-	?	?	?	?	?	?	?	?
This UAV remains in development and is anticipated sometime after 2020.[94]														
GSV-37 BREEZE	Russia	Radar MMS	Rotary Wing		Small	Navy	Recon, Patrol	90 min	35	1	60	80	18	No
This helicopter UAV is in development for the Russian Navy.[95]														
HORIZON AIR S-100 CAMCOPTER S-100 ГОРИЗОНТ ВОЗДУШНЫЙ С-100	Austria	Schibel, OAO Gorizont	Rotary Wing		Tactical	Navy, Coast Guard	Recon	6–10 hours	200	5.5	190	220	150	No
The *Horizon Air* S-100 is the Russian variant of the multipurpose *Schiebel Camcopter* S-100 UAV. This UAV was used during the 2014 Sochi Olympic Games over the Black Sea shoreline and has been successfully tested aboard *Rubin*-class Maritime Border Patrol vessels with the Russian Coast Guard. After completing tests in the Baltic Sea, this UAV will operate from the Russian icebreaker *Viktor Chernomyrdin*.[96]														
KUB-BLA КУВ-БЛА (CUBE-UAV)	Russia	Kalashnikov	Fixed Wing		Mini	-	Recon, Combat	30 minutes	3	?	80	130	40	Yes
First unveiled at the International Exhibition of Arms and Military Equipment (IDEX-2019), this UAV is described as a "kamikaze" drone with a small explosive charge. Developers claim that it is able to attack targets based off either coordinates or uploaded images of the target, and that it has been tested successfully and is ready for use.[97]														
KATRAN КАТРАН	Russia	Russian Helicopter Group	Rotary Wing	II	Tactical	Navy, Army	Recon, FS	4 hours	490	4	<130	130	?	No
First shown at the night-time rehearsals for the 2018 Victory Parade in Moscow, state media reported that the *Katran* was scheduled to undergo test flights in late 2018 and early 2019.[98]														
KORSAR КОРСАР CORSAIR	Russia	OKB Luch (Rostec)	Fixed Wing	II	Tactical	-	EW, ISR	8 hours	200	5.1	120	125	120	No
The *Korsar* was shown during the night-time rehearsals for the 2018 Victory Parade in Moscow alongside the *Katran* helicopter UAV, and at the International Military-Technical Army Forum 2019 in Moscow.[99]														
LANTSET-1 ЛАНЦЕТ-1 (LANCET-1)	Russia	Kalashnikov	Fixed Wing	I	Mini	-	Recon, Combat	30 minutes	5	?	>80	110	40	Yes
First introduced at the Army 2019 defence exhibition in Kubinka, Russia in June 2019, the *Lancet* is a "kamikaze"-type weapon. It is a lighter *Lancet*-1, with a 1kg warhead, and was not displayed at the exhibition unlike its heavier brother, the *Lancet*-3.[100] State media reported that factory tests had been completed that summer.[101]														
LANCET-3 ЛАНЦЕТ-3 (LANCET-3)	Russia	Kalashnikov	Fixed Wing	I	Mini	-	Recon, Combat	40 minutes	12	?	>80	110	40	Yes
Shown for the first time at the Army 2019 defence exhibition in Kubinka, Russia in June 2019, this UAV is a "kamikaze"-type weapon. It comes in two configurations *Lancet*-3 is heavier and comes with a 12kg warhead.[102] State media reported that factory tests had been completed that summer.[103]														

91. Valery Butymov, "MAKS-2019: UAV Berta Gets Turbojet," Mil.Today, 16 August 2019.
92. Atherton, "Will Russia replace Orlan orbits?".
93. Marco Margaritoff, "Russian Company Builds Flying Model of Multipurpose Frigate Drone," *The Drive*, 7 August 2017.
94. *Russia Military Power: Building a Military to Support Great Power Aspirations* (Washington, DC: Defense Intelligence Agency, 2017), 64.
95. Oliver, "Russia's Rapid UAV Expansion."
96. Ibid.; see also "Ispytaniya bespilotnogo vertoleta priznany uspeshnymi" [Trials of an unmanned helicopter deemed successful], *Voyennoye obozreniye*, 30 November 2011.
97. Kyle Mizokami, "Kalashnikov is Getting into the Business of Self-Destructing Drones," *Popular Mechanics*, 20 February 2019.
98. "Russia to start trials of most advanced Katran combat drone this year," TASS, 24 August 2018.
99. "Na repetitsii parada v Moskve vpervyye pokazali BLA 'Korsar'" ["Korsar" UAV was shown for the first time during a parade rehearsal in Moscow], *Voyennoye obozreniye,* 27 April 2018; "Na 'Armii-2009' vpervyye predstavili rossiyskiy bespilotnik 'Korsar'" ["Korsar" Russian unmanned aerial vehicle presented for the first time at "Army-2009"], TASS, 25 June 2019.
100. Miko Vranic, "Army 2019: Kalashnikov shows 'kamikaze' UAS for first time," *Jane's*, 27 June 2019.
101. "'Kalashnikov' zavershil ispytaniya udarnogo bespilotnika-kamikadze 'ZALA Lantset'" [Kalashnikov has completed trials of the "ZALA Lancet" kamikaze strike unmanned aerial vehicle], TASS, 3 July 2019.
102. Vranic, "Army 2019."
103. "'Kalashnikov' zavershil ispytaniya," TASS.

<table>
<tr><td>MIKOYAN SKAT
МИКОЯН СКАТ
MIKOYAN RAY</td><td>Russia</td><td>Russian Aircraft Corporation MiG</td><td>Fixed Wing</td><td>III</td><td></td><td>Air Force</td><td>Combat</td><td>3 hours</td><td>9,070</td><td>12</td><td>>800</td><td>800</td><td>2,000</td><td>Yes</td></tr>
<tr><td colspan="15">The current development status of the Mikoyan Skat is not particularly clear. Development began in 2005 and it was later showcased publicly at MAKS-2007. The project was suspended in 2012. However, in June 2019, MiG director general Ilya Tarasenko stated that a technical task force for the Skat UAV was planned and was likely to be approved by the Russian MoD. If development continues, some sources have predicted that, like the Okhotnik-B to the Su-57, the Mikoyan Skat will act in tandem with the MiG-35 fighter jet.[104]</td></tr>
<tr><td>OKHOTNIK-B
S-70 OKHOTNIK
ОХОТНИК
(HUNTER)</td><td>Russia</td><td>Sukhoi and RSK MiG</td><td>Fixed Wing</td><td>III</td><td>Strike</td><td>Air Force</td><td>Combat, ISR</td><td>>30 minutes</td><td>25,000</td><td>>0.6–12</td><td><1,000–14,000</td><td>1,000–14,000</td><td>6,000</td><td>Yes</td></tr>
<tr><td colspan="15">Growing out of the Mikoyan Skat project, this UAV is unlikely to complete development until 2025 or later. In August 2019, the Russian MoD released a video and press release stating that the Okhotnik made its maiden flight over the Chkalov State Flight Test Centre in Astrakhan and flew for about 20 minutes at about 600m.[105] In September 2019, the MoD announced that the Okhotnik had operated autonomously with Su-57s and flew for over 30 minutes.[106] Some analysts have inferred that the UAV may be intended to work in tandem with manned high-performance jets like the Su-57 in a “loyal wingman” role while other observers have noted that the UAV’s engine configuration may hinder its intended stealth capabilities.[107]</td></tr>
<tr><td>ORION
ОРИОН
INOKHODETS
ИНОХОДЕЦ
(PACER)</td><td>Russia</td><td>Kronstadt Group</td><td>Fixed Wing</td><td>III</td><td>MALE</td><td>-</td><td>Combat, ISR, EW</td><td>24 hours</td><td>1,000</td><td>7.5</td><td>120</td><td>225</td><td>250</td><td>Yes</td></tr>
<tr><td colspan="15">First revealed publicly at the MAKS-2017 air show and developed under the code name Inokhodets, a strike-capable variant of the Orion UAV was showcased in September 2018.[108] State media reported that the Orion was undergoing experimental combat field testing in Syria near Idlib in November 2019, but it may have been tested in Syria for surveillance and reconnaissance as early as 2018.[109] In addition, state media reported in November 2019 that an Orion UAV crashed in Listvyanka, Ryazan Region.[110]</td></tr>
<tr><td>ORION-E
ОРИОН-Э</td><td>Russia</td><td>Kronstadt Group</td><td>Fixed Wing</td><td>III</td><td>MALE</td><td>-</td><td>Combat, ISR</td><td>24 hours</td><td>1,000</td><td>7.5</td><td>200</td><td>225</td><td>250</td><td>No</td></tr>
<tr><td colspan="15">First presented at MAKS-2017, the export variant of the Orion drone is not currently weaponised and is limited to surveillance and reconnaissance.[111] In August 2018, the director of Russia’s arms export bureau stated that an unnamed country in the Middle East had placed an order for the UAV.[112] One possible future customer could be the United Arab Emirates, as Russian state media reported that the UAE was considering holding trials for the UAV following the 2019 Dubai Airshow.[113]</td></tr>
<tr><td>ORION-2
ОРИОН-2
SIRIUS
СИРИУС</td><td>Russia</td><td>Kronstadt Group</td><td>Fixed Wing</td><td>III</td><td>HALE</td><td>-</td><td>Combat, ISR</td><td>24 hours</td><td>5,000</td><td>12</td><td>295</td><td>350</td><td>5,000</td><td>Yes</td></tr>
<tr><td colspan="15">The Orion-2 was shown at MAKS-2019 alongside its smaller brother, although at the time it was unnamed. A larger version of the Orion designed for higher altitudes and longer operation, it is said the Orion-2 is being developed primarily to patrol the Arctic and Pacific oceans and EEZs.[114] The first flight of the Orion-2 is expected in 2023.[115]</td></tr>
<tr><td>VEYER
ВЕЕР
(FAN)</td><td>Russia</td><td>ENICS</td><td>Rotary Wing</td><td></td><td>Micro</td><td>-</td><td>Combat, ISR</td><td>?</td><td>4</td><td>?</td><td>?</td><td>?</td><td>10</td><td>Yes</td></tr>
<tr><td colspan="15">Lightweight quadcopter UAV first shown at the Army-2019 forum. The manufacturer states that, while the primary use is reconnaissance, it is capable of carrying hand grenades.[116]</td></tr>
<tr><td>VORON 777-1
ВОРОН 777-1
(RAVEN 777-1)</td><td>Russia</td><td>Iskat Design Bureau</td><td>Rotary Wing</td><td></td><td></td><td>-</td><td>ISR, EW</td><td>4 hours</td><td>90</td><td>5.5</td><td>?</td><td>?</td><td>?</td><td>No?</td></tr>
<tr><td colspan="15">In 2017, state media reported that the Voron 777-1 had completed all state testing and was expected to enter the market in 2018 or 2019.[117]</td></tr>
<tr><td>BRIZ
БРИЗ
(BREEZE)</td><td>Russia</td><td>Radar MMS</td><td>Rotary Wing</td><td>I</td><td>Mini</td><td>-</td><td>ISR</td><td>2.5 hours</td><td>45</td><td>1.5</td><td>-</td><td>75</td><td></td><td>No</td></tr>
<tr><td colspan="15">Showcased at the Army 2020 Military Technology Exposition, this platform was originally designed to support civilian missions such as search-and-rescue operations, ice reconnaissance, assessment of disaster consequences, monitoring of critical infrastructure and environmental monitoring. However, its potential customers also include security agencies (border, counterterrorism) and the armed forces. It can carry a payload of up to 10kg that can include gyro-stabilised optoelectronic systems (HD camera, thermal imager, laser rangefinder, multispectral camera), sensors and devices for environmental radiation monitoring (gas analyser, gamma radiation detector, laser methane detector, digital camera), specialised all-weather search systems (quantum four-chamber magnetometer, small radar), and acoustic systems and lighting devices (LED spotlight, motional feedback loudspeaker).[118]</td></tr>
</table>

104. “Istochnik: RSK ’MiG’ vozobnovila raboty nad udarnym bespilotnikom ’Skat’“ [Source: MiG resumed work on “Skat” unmanned aerial strike vehicle], TASS, 11 September 2018; Anton Valagin, “MiG sozdast tyazhelyy udarnyy bespilotnik” [MiG will develop a heavy unmanned aerial strike vehicle], *Rossiyskaya gazeta*, 17 July 2019.
105. “Russian heavy strike drone Okhotnik makes first flight,” TASS, 3 August 2019.
106. Nicholas Fiorenza, “Russia’s Okhotnik UAV makes first flight with Su-57,” *Jane’s*, 27 September 2019.
107. On the “loyal wingman” role, see Joseph Trevithick, “Russia’s ‘Hunter’ Flying Wing Unmanned Combat Air Vehicle is a Big Beast,” *The Drive*, 21 May 2019; on stealth capabilities, see Sebastien Roblin, “How Good is Russia’s New Sukhoi S-70 Okhotnik-B ‘Hunter’ Stealth Drone?,” *The National Interest*, 17 December 2019.
108. Gettinger, *The Drone Databook*, 71.
109. “Russia’s Orion attack drone arrives for troops after Syria experience — source,” TASS, 1 November 2019.
110. “Voyennyy bespilotnik ’Orion’ rukhnul vblizi zhilykh domov v Ryazanskoy oblasti“ [“Orion” military unmanned aerial vehicle crashed near residential buildings in Ryazan oblast], TASS, 16 November 2019.
111. Tamir Eshel, “Russian Push for Drone Export,” *Defense Update*, 3 April 2019.
112. Gettinger, *The Drone Databook*, 71.
113. “Russia, UAE mull testing latest Orion-E reconnaissance drone,” TASS, 18 November 2019.
114. Aditya Jadhav, “MAKS 2019: Kronshtadt Group unveils new MALE UAV development,” *Jane’s*, 2 September 2019.
115. Vladimir Karnozov, “Enlarged Derivative of Orion UAV Under Development,” AINonline, 10 September 2019.
116. Valery Butymov, “‘Fan’ Throwing Grenades: Russia Shows New Drones,” Mil.Today, 27 June 2019.
117. “V Rossii sozdali novyy bespilotnyy vertolet, soobshchil istocnik” [New unmanned combat helicopter developed in Russsia, source reports], RIA Novosti, 16 June 2017.
118. “Rotary-Wing Unmanned Aircraft System ‘Briz’,” Radar MMS, last accessed 11 February 2021; Kelsey D. Atherton, “Russian Robot Helicopter Could Do More Than Search and Rescue,” *Forbes*, 20 August 2020.

B.3 Russian UUVs and USVs

It is reported that at least 17 UUVs are currently in development by Russia.[119] However, many more UUVs and Unmanned Surface Vehicles (USVs) are currently under development or already in use. This annex displays some of the most notable examples.

<table>
<tr><th>NAME(S)</th><th>MANUFACTURER(S)</th><th>ORIGIN</th><th>PURPOSE</th><th>WEIGHT</th><th>RANGE</th><th>MAX DEPTH</th><th>SPEED</th><th>OPERATIONAL TIME</th><th>ARMED</th></tr>
<tr><td>AMULET
АМУЛЕТ</td><td>Rubin Central Design Bureau</td><td>Russia</td><td>Research</td><td>25kg</td><td>15km</td><td>50m</td><td>3 knots</td><td>4 hours</td><td>No</td></tr>
<tr><td colspan="10">Reported to have been tested at the Feodosia Naval Base in Crimea alongside the Amulet in preparation for sale on the world market in 2018. [120]</td></tr>
<tr><td>TSEFALOPOD
ЦЕФАЛОПОД
(CEPHALOPOD)</td><td>Rubin Central Design Bureau</td><td>Russia</td><td>Combat</td><td>?</td><td>?</td><td>?</td><td>?</td><td>?</td><td>Yes</td></tr>
<tr><td colspan="10">Development of the Cephalopod has been taking place since at least 2015, when it was revealed alongside the Poseidon UUV. The Cephalopod is armed with 324mm MTT lightweight torpedoes and appears to be designed to engage enemy submarines.[121]</td></tr>
<tr><td>KONTSEPT-M
КОНЦЕПТ-М
(CONCEPT-M)</td><td>Tetis Pro</td><td>Russia</td><td>Recon</td><td>150kg</td><td>150km</td><td>1km</td><td>5 knots</td><td>17 hours</td><td>No</td></tr>
<tr><td colspan="10">First tests occurred in the Black Sea near Gelendzhik in June 2014 and it was later presented at the Interpolitex 2014 Security Equipment Exhibition.[122] Intended to replace the Icelandic Gavia UUV in the Russian Navy.[123]</td></tr>
<tr><td>GARMONIYA-GID
ГАРМОНИЯ-ГИД
(HARMONY-GUIDE)</td><td>Rubin Central Design Bureau</td><td>Russia</td><td>?</td><td>?</td><td>?</td><td>?</td><td>?</td><td>?</td><td>?</td></tr>
<tr><td colspan="10">Few details exist regarding this unconfirmed Russian UUV other than it is probably a large-displacement UUV. The project may even have been cancelled in 2018; its current status is unclear.[124]</td></tr>
<tr><td>GALTEL
ГАЛТЕЛЬ</td><td>Institute of Marine Technology Problems</td><td>Russia</td><td>Recon, Demining, Research</td><td>?</td><td>100km</td><td>300–400m</td><td></td><td>24 hours</td><td>No</td></tr>
<tr><td colspan="10">Reported to have been tested in the Syrian port of Tartus.[125] This UUV was first unveiled in 2012 at the APEC summit in Vladivostok.[126]</td></tr>
<tr><td>GAVIA
ГАВИА</td><td>Teledyne Gavia</td><td>Iceland</td><td>Research, Recon</td><td>49–79kg</td><td>?</td><td>2km</td><td>5.5 knots</td><td>7 hours</td><td>No</td></tr>
<tr><td colspan="10">The Russian Navy began receiving Gavia UUVs in 2013.[127] The Concept-M is intended to enter mass production and replace the Gavia in the Russian Navy.[128]</td></tr>
<tr><td>GLAYDER-T
ГЛАЙДЕР-Т
(GLIDER-T)</td><td>"Compass" Moscow Design Bureau</td><td>Russia</td><td>EW, Recon</td><td>?</td><td>?</td><td>100m</td><td>0.5 knots</td><td>?</td><td>No</td></tr>
<tr><td colspan="10">Unveiled at Army-2015, Russian state media reported this UUV was capable of electronic interference, underwater vehicle imitation and underwater reconnaissance.[129]</td></tr>
<tr><td>GLAYDER 2.0
ГЛАЙДЕР 2.0
(GLIDER 2.0)</td><td>Okeanos Scientific and Production Enterprise</td><td>Russia</td><td>Research</td><td><150kg</td><td>?</td><td>?</td><td>0.5 knots</td><td>6–9 months</td><td>No</td></tr>
<tr><td colspan="10">Acquired in 2016 by the Russian Navy, this UUV includes the Glider 2.1, a revised iteration with a folding propeller. Primarily used for research, as of 2016, military use was still at the prototype stage.[130]</td></tr>
</table>

119. "V Rossii razrabatyvayut 17 podvodnyh bespilotnikov" [17 unmanned undersea vehicles are being developed in Russia], RIA Novosti, 31 October 2018.
120. "Podvodnye bespiltonye razvedchiki 'Amulet' i 'Yunona' gotovy vyyiti na myrovoy rynok" ["Amulet" and "Yunona" unmanned undersea reconnaissance vehicles are ready to enter world market], *Narodnye novosti* (*People's News*), 8 August 2019.
121. Kyle Mizokami, "Russia Working on New 'Cephalopod' Underwater Attack Drone," *Popular Mechanics*, 30 July 2018.
122. Anatoliy Sokolov, "'Kontsept-M': Robot dlya podvonogo monitoringa" ["Concept-M": Robot for underwater monitoring], Interpolitex, 2014.
123. "Russian Navy to Get Five Advanced Unmanned Underwater Vehicles by 2016," Sputnik, 12 August 2015.
124. H.I. Sutton, "Russian Autonomous Underwater vehicle Garmoniya – Guide," Covert Shores, 12 September 2019.
125. "Podvodnyy robot 'Galtel'' uspeshno vypolnil boyevuyu zadachu v Sirii – chlen kollegii VPK" ["Galtel" undersea robot 'has successfully completed combat assignment in Syria, says a member of VPK collegium], Interfax, 22 February 2018.
126. Timur Alimov, "Kak ustroena priminyaemaya v Sirii pervaya v RF podlodka-robot" [How Russia's first undersea robot is employed in Syria], *Rossiyskaya gazeta*, 9 August 2017.
127. "VMF RF poluchil pervuyu partiyu podvodnyh apparatov 'Gavia'" [Russian Navy has received first batch of "Gavia" undersea machines], RIA Novosti, 20 August 2013.
128. "Russian Navy to Get Five Advanced Unmanned Underwater Vehicles by 2016," Sputnik.
129. "Rostec and OPK New Glider-T Autonomous Underwater Vehicle Can Navigate Without GLONASS," *Navy Recognition*, 29 June 2015.
130. Alexey Moiseev and Nikolay Surkov, "Minoborony poluchit sverkhavtonomnyy podvodnyy planer" [Mindef will receive highly autonomous undersea glider], *Izvestiya*, 19 December 2016.

KLAVESIN-1R КЛАВЕСИН-1Р (HARPSICHORD-1R)	Rubin Central Design Bureau and the Institute of Marine Technology Problems	Russia	Research	2,500kg	300km	6km	2.9 knots	120 hours	No
Used to search for remnants of the Tu-134 aircraft that crashed in the Gulf of Tatar on 6 November 2009 and to survey the Lomonosov Ridge in the Arctic Ocean. [131]									
KLAVESIN-2R-PM КЛАВЕСИН-2Р- ПМ (HARPSICHORD-2R-PM)	Rubin Central Design Bureau for Marine Engineering	Russia	Research	3,700	50km	6km	?	?	No
A newer iteration of the *Klavesin*-1R, this UUV was reportedly tested at the marine training grounds in Crimea in the spring of 2018.[132] It is believed that Project 09852 based on the Project 949A (*Oscar* II-class) submarine *Belgorod* and Project 09787 Special-Purpose Submarine BS-64 *Podmoskovye* could be equipped with this UUV.[133]									
YUNONA ЮНОНА	Rubin Central Design Bureau for Marine Engineering	Russia	Research	80kg	50km	1km	5–6 knots	6 hours	No
Reported to have been tested at the Feodosia Naval Base in Crimea alongside the *Amulet* in preparation for sale on the world market in 2018. [134]									
MARLIN-350 МАРЛИН-350	Tetis Pro	Russia	Research, Search and Rescue, Engineering, Guarding	50kg	450m	-	2 knots	-	No
This UUV completed tests in October 2016 and was adopted by the Russian Navy shortly afterwards.[135] Intended to be a domestic replacement for the British *Tiger* UUV.[136]									
NERPA НЕРПА	TSNIITOCHMASH and MAKO, aka (Rostec)	Russia	Patrolling, Guarding	30kg	?	50m	?	4 hours	Yes
Revealed at the Army 2018 International Military-Technical Forum, this UUV is armed with an APS underwater rifle beneath the UUV and is intended to counter enemy divers and small aquatic craft. Testing was expected in the winter of 2018.[137]									
POSEYDON ПОСЕЙДОН STATUS-6 СТАТУС-6	Rubin Central Design Bureau for Marine Engineering (United Shipbuilding Corporation)	Russia	Nuclear deterrence	50,000kg	Practically unlimited	1km	78–107 knots	Practically unlimited	Yes
Autonomous nuclear-powered UUV capable of launching both conventional and nuclear payloads (nuclear blast yield between 2 and 100 megatons), likely to be carried by Project 09852 based on Project 949A (*Oscar* II-class) *Belgorod* and Project 09851 *Khabarovsk* submarines.[138] In November 2015, a classified diagram of the "Oceanic Multipurpose System – Status 6" was leaked (probably intentionally) during a broadcast on state-owned Channel One.[139] In November 2016, independent US media reported that the US intelligence agencies had identified Russian testing of the UUV.[140] In January 2019, state media reported that the Russian Navy would be procuring 32 *Poseydon* UUVs: two *Poseydon*-carrying submarines with the Northern Fleet and with the Pacific Fleet. Each would be equipped with eight UUVs.[141] During his State of the Nation address, president Putin confirmed Russian efforts to develop the *Poseydon* UUV.[142] In February 2019, Putin announced the completion of *Poseydon* trials and days later the Russian MoD released a video of a *Poseydon* being test-launched by a B-90 *Sarov* submarine in the Arctic Ocean.[143]									
SEASCAN MK2	ECA Group	France	Mine counter-measures, Surveying, Critical Infrastructure Protection, Search and Rescue	50kg	2,000m	300m	6 knots	3 hours	No
This has been delivered to Russia as part of the Unmanned Survey and Identification System for Project 12700 MCM Vessels in 2016–18, to be operated either from mother ships or from Inspector MK2 USVs as platforms. Its standard payload includes high-resolution sonar, colour video camera and LED searchlight, while optional payload can be launching and recovery devices, manual or electrical FO winch, pan-and-tilt digital camera etc. [144]									

131. Vladimir Tuchkov, "Nayti i obezvredit': Siriyskiy opyt podvodnykh dronov VMF RF" [Search and disarm: Syrian experience of Russian Navy's undersea drones], *Svobodnaya pressa*, 25 February 2018; "Podvodnye roboty Vladivostoka trudyatsya na blago rossiyskoy ekonomiki i nauki" [Vladivostok's undersea robots work for the Russian economy and science], *Yezhednevnye novosti Vladivostoka* (*Vladivostok Daily News*), 25 July 2016.
132. "Minoborony ispytyvayet v Krymu noveyshiy podvodnyy bespilotnik 'Klavesin' – SMI" [Mindef is testing newest undersea unmanned vehicle, "Klavesin", in Crimea – media], Interfax, 3 August 2018.
133. Nikolay Surkov, Alexey Ramm & Evgeny Dmitriev, "Podvodnogo razvedchika spryachut v konteyner" [Undersea spy will be concealed in a container], *Izvestiya*, 20 April 2018.
134. "Podvodnye bespiltonye razvedchiki 'Amulet' i 'Yunona' gotovy vyyiti *na myrovoy rynok*," *Narodnye novosti*.
135. Vasily Sychev, "Rossiyskiy flot vooruzhitsya desyat'yu podvodnymi robotami" [Russian navy will be armed with ten undersea robots], *N+1*, 13 July 2016.
136. "Russian Navy to Get Five Advanced Unmanned Underwater Vehicles by 2016," Sputnik.
137. "V Rossii razrabotali pervyy v mire podvodnyy bezpilotnik s avtomatom" [World's first unmanned undersea vehicle with an assault rifle developed in Russia], RIA Novosti, 21 August 2018; "Rostekh pokazal prototip podvodnogo protivodiversionnogo robota na 'Armii-2018'" [Rostech showed a prototype of an undersea counter-sabotage robot at "Army-2018"], TASS, 21 August 2018.
138. David Hambling, "The Truth Behind Russia's 'Apocalypse Torpedo'," *Popular Mechanics*, 18 January 2019.
139. Matthew Bodner, "Russia Leaks Dirty-Bomb Submarine Drone in State TV Broadcast," *Defense News*, 13 November 2015.
140. Bill Gertz, "Russia Tests Nuclear-Capable Drone Sub," *The Washington Free Beacon*, 8 December 2016.
141. "Russian Navy to put over 30 Poseidon strategic underwater drones on combat duty – source," TASS, 12 January 2019.
142. "First sub to carry Poseidon underwater nuke drone to begin sea trials in 2020," TASS, 10 September 2019.
143. "Russia Releases Video of New Poseidon Nuclear-Powered Underwater Drone," AP, 20 February 2019.
144. "ECA Group Delivers Second USV Inspection System to Russia for Project 12700 MCM Vessel," *Navy Recognition*, 26 July 2017; "Inspector Mk2 Mine Countermeasures USV," Naval Technology, last accessed 11 February 2021; "SeaScan MK 2," ECA Group, last accessed 11 February 2021.

MORSKAYA TEN МОРСКАЯ ТЕНЬ (SEA SHADDOW)	St. Petersburg State Marine Technical University and the St. Petersburg Scientific-Production Enterprise of Underwater Technologies "Oceanos"	Russia	?	150kg	?	?	2 knots	?	No
First revealed at the 2017 Army Exhibition and Forum, the *Morskaya Ten* (*Sea Shadow*) glider was reportedly tested in the Baltic Sea in August 2017.[145]									
SURROGAT СУРРОГАТ (SURROGATE)	Rubin Central Design Bureau for Marine Engineering (United Shipbuilding Corporation)	Russia	Recon, Research	40kg	965km	600m	24 knots	15–16 hours	No
Described as having a modular design that will be able to replicate the acoustics and electromagnetic signature of nuclear submarines and non-nuclear ships, allowing the UUV to mimic other vessels.[146]									
VITYAZ ВИТЯЗЬ	Rubin Central Design Bureau for Marine Engineering (United Shipbuilding Corporation) and Advanced Research Foundation	Russia	Research	5,600kg	?	10,000m	?	18 hours	No
Initiated in 2017 as a project to develop a prototype of a fully autonomous undersea vehicle for deep ocean exploration. The first prototype made a successful descent to the bottom of the Mariana Trench in the Pacific in 2020, with further tests scheduled in other areas. The outcomes of the project will be handed over to two customers–the Russian Academy of Sciences and the MoD–for further development and adaptation to their needs.[147]									
INSPECTOR MK2 ИНСПЕКТОР МК2	ECA Group	France	Mine counter-measures	4,300kg	?	-	35 knots	12 hours (at 10 knots)	No
Inspector MK2 is a multipurpose surface platform that can operate in autonomous, remote-control and manned modes. It has been delivered to Russia as part of Unmanned Survey and Identification System for Project 12700 MCM Vessels. The ECA Group contract stipulated delivery of three such USVs in 2016–18, with SEASCAN UUVs as part of the payload.[148]									

145. "Podvodnyy robot-nevidimka 'Morskaya ten'' zavershil ispytaniya na Baltike" ["Sea Shadow" invisible undersea robot has completed trials in the Baltic], RIA Novosti, 28 September 2017.
146. "Dlya VMF RF sozdayetsya robot, sposobnyy imitirovat' lyubuyu podlodku" [A robot capable of imitating any submarine is being developed for the Russian Navy], TASS, 6 December 2016.
147. "Avtonomnyy glubokovodnyy apparat 'Vityaz' opustilsya na dno Marianskoy vpadiny" ["Vityaz" autonomous deep-sea machine has descended to the bottom of the Mariana trench], Advanced Research Foundation, 9 May 2020; Milena Sineva, "Zamestitel' glavy FPI ob apparate 'Vityaz': dlya nas net ogranicheniy po glubine" [Deputy head of the Advanced Research Foundation on "Vityaz": We do not have limitations regarding depth], TASS, 8 June 2020.
148. "ECA Group Delivers Second USV Inspection System," *Navy Recognition*; "Inspector Mk2 Mine Countermeasures USV," Naval Technology.

Annex C. Some Likely Characteristics of Roboticised Force Employment by Russia in Future Conflicts

Force employment characteristics in each conflict depend on the specific political-military situation, strategic context and a number of interdependent factors such as the level of achieved technology development (e.g. in machine autonomy) and the nature of countermeasures used by the opposing forces. Some of the aspects described in this annex are already technically possible today, while others will mature within the next five to ten years or longer. It must also be kept in mind that the operational effects are usually created by a combination of various capabilities. Russia's unmanned systems will inevitably be part of a larger and complex system of systems, and their full potency should therefore be assessed in conjunction with other capabilities. This annex focuses on outlining the most salient aspects related to the employment of military robots by Russia in a hypothetical hybrid and conventional local or regional conflict in its geographical vicinity.

In hybrid conflict:

- Russia's aim—to influence an adversary without crossing the threshold of open armed conflict while keeping tensions close to this—would greatly benefit from creative and flexible use of unmanned systems.
- Aerial and undersea systems in particular would be flexible and easily employable instruments to regulate tensions with the adversary, without declaring and mobilising for open armed conflict. Lack of adequate opposing air and maritime (surface and subsurface) surveillance capability in a particular theatre of operations would allow Russia to deploy these systems quite freely.
- The systems can be used to gain situational awareness, confuse the adversary, inflict damage on critical infrastructure and conduct psychological and information warfare.
- The use of widely available commercial systems would also enable denial of their ownership and employment by Russia's security or military organisations, and potentially by local proxies and agents.
- In some cases, however, deniability would not be sought in order to demonstrate to an adversary its inability to deny the extensive use of unmanned systems by Russia in the adversary's airspace, territorial waters and EEZ, and thus keep its society safe.
- Unmanned aerial or undersea vehicles, or even swarms of them, would be used for harassment and intimidation of the adversary's civilian population or military personnel as well as to disrupt critical services (e.g. civil aviation, maritime transport, telecommunications or energy supply) that would place additional psychological strain on the targeted society.

In open armed conflict:

- Russia would deploy its combat robots largely to find and fix the adversary, including in rear areas, and enable a fast and aggressive advance.
- The employment of UAVs would be massive and electronic countermeasures would not be able to deny their use due to the high level of autonomy in orientation and mission execution that reduces the need for permanent communication between the UAV and the command centre.
- UAVs would be an integral part of the sensor system feeding into the Russian AI-enabled C2 system (e.g. ASU) that plans the missions for all units. As data transmission would be automated and data fusion would be empowered by the AI, this would enable rapid engagement of any operationally relevant target. However, limited bandwidth would

require optimisation of communication, and thus combined human–machine battle teams would be quite independent in the execution of tasks.

- In addition to indirect fire and missiles, the enemy would be engaged by armed UAVs and loitering munitions that find and destroy targets in a designated area of operations as a single system or in swarm formations. The ability to concentrate and disseminate UAVs would provide a dynamic asset to overload the enemy's capabilities for appropriate aerial situational awareness and effective countermeasures.

- The presence of Russian UAVs on the battlefield and in rear areas would be permanent. The UAVs would be used in all levels of units and processed information gathered from flying sensors would be distributed vertically and horizontally, up and down. This enables the operational tempo to be maintained and the fire to be used optimally and effectively.

- The military robots would be an integral part of electronic warfare. Synchronisation of jammed and data-exchange frequencies would be machine-based. Unmanned systems would carry EW equipment in order to neutralise the adversary's communications systems.

- A combination of unmanned ground systems that demine, clear roads and engage the enemy with weapons systems would move as a spearhead. The UAVs would provide situational awareness and hit the opposing forces beyond the line of sight. This unmanned heavy spearhead, in orchestration with indirect fire, would find and fix the enemy, thus providing the main troops an opportunity to enter the fight with good situational understanding and on-flight, without reducing their operational tempo. The manned units would be used to leverage the success achieved by precision fire, artillery and unmanned systems.

- In urban areas, robotic systems would be used intensively. Finding and fixing the enemy and controlling the flanks would be unmanned. Robot-on-robot battles would be part of regular CONOPS, and pauses in operations would be defined by the need for system maintenance, not by human fatigue.

- Robotic combat systems would engage autonomously in a given pre-programmed operational area. The engagement of the enemy's systems and soldiers would be automated and unencumbered by concerns over potential collateral damage. The operational tempo would be kept high in order to preserve the initiative, while sacrificing unmanned systems to gain decisive momentum would be an acceptable modus operandi.

- Using unmanned systems in a combined way, the effect of omnipresence of military robots would be created, especially along the main axes of operations. For the enemy that does not have effective counter-systems, the effect of the permanent potential presence of unmanned lethal or non-lethal systems would provoke certain "U-fear" (U for "unmanned")—the fear of being permanently under surveillance, influence and threat of attack. This would cause mental and physical exhaustion among the troops and diminish their ability to fight effectively.

- Fighting troops would be sustained by delivery of supplies by UGVs. This would enable forces to be deployed in positions that could otherwise be seen as too risky due to lack of secured supply roads. Autonomous "mules" would provide opportunities for more flexible and optimised logistical support. Unmanned systems would carry human casualties to medical care or collection points and evacuate disabled platforms.

- Massive employment of military robots and the corresponding demand for their technical maintenance would lead to redesigned logistical support. The need to keep the unmanned spearhead running at a high pace would require the positioning of high-tech maintenance close to the combat area.

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