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Research Report

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Logistics and Sustainment in the Russian Armed Forces

The failures in the Russian logistics and maintenance system have been identified in several open-source reports as a key factor of Russia's underperformance in Ukraine in 2022.[1] Despite renewed interest in the topic, Russia's military logistics and sustainment remain an under-researched area in the West. In this report, I present a brief overview of Russia's material logistics and sustainment system and its problems as identified by Russian authors prior to February 2022. Because it is inherently challenging to study an ongoing war, I also attempt to outline and characterize some of the factors that might have affected Russian performance during the first months of the expanded war between Russia and Ukraine from February to May 2022.

KEY FINDINGS

- Russia has a large and elaborate military logistics and sustainment system. Although Russia has been increasingly exercising some parts of its logistics and sustainment system prior to the 2022 war with Ukraine, it lacked recent experience with supporting a large-scale ground operation. It was also marred by various long- and short-term challenges, reflected in the writings by Russian experts.
- Russia's long-term logistics and sustainment challenges include such broader systemic issues as resource inefficiency in the military and the defense industry; inadequate warehousing for fuel and food; unsuccessful, partially implemented, or ongoing reforms in military logistics and sustainment; and corruption.
- Large-scale ground operations by Russian forces will likely continue to present lucrative opportunities for long-range strikes to disrupt logistics because of the continued Russian reliance on rail for high-bandwidth resupply and the need to move vast quantities of bulky unguided artillery ammunition for fire support. However, the arrival of long-range strike weapons in Ukraine is beyond the time frame of this report.
- Russia's military logistics and sustainment system would benefit from further research into potential limitations and vulnerabilities. As when studying other aspects of foreign militaries, the logistics and sustainment system needs to be considered with an understanding of the broader military planning, political, cultural, industrial, and other dimensions of Russia. Some unique aspects of the Ukraine conflict will not apply to future scenarios that more directly involve the North Atlantic Treaty Organization, and, consequently, the lessons of Ukraine alone should not be the basis for further study.

To better describe Russian concepts related to logistics and sustainment, I reviewed dozens of unclassified documents and articles, including relevant Russian legislation, articles from Russian military-scientific publications and encyclopedias, and media reports. The documents I reviewed were primarily, although not exclusively, Russian-language sources. They were identified through searching databases of Russian scholarly articles and through reference mining. I used sources published between 2015 and 2022 to reflect information that is relevant to the state of the Russian military following the latest military reforms of the past decade. I was limited by the scarce availability of recent, verifiable information about the finer structure and state of Russian logistics and sustainment units. Detailed information about how day-to-day logistics function at the unit level is also sparce. Furthermore, as of 2022, the Russian government has criminalized the discussion of many military capabilities–related topics, further reducing available information.[2] Although there is an ample body of analytical and research knowledge on the problems, challenges, and solutions to Russia's logistics and sustainment issues, it is unclear to what extent the military decisionmakers apply the research in practical problem-solving.[3]

I have chosen to use relevant Russian terminology throughout the report, specifically the term *material-technical support* (MTO), defined as "all types of daily and combat activities for the maintenance of troops and forces in constant readiness so that they are able to performs tasks as needed."[4] I sought to maintain the uniqueness of the Russian terminology because Russian logistics and sustainment terminology is not a direct translation of the terminology or the concepts used in English. Box 1 presents key Russian terminology.

BOX 1

Key Russian Terminology

- MTO (*materialno-tehnicheskoye obespecheniye*), also translated as "logistics support": includes "all types of daily and combat activities for the maintenance of troops and forces in constant readiness so that they are able to performs tasks as needed."[a] Note that some Russian sources translate materialno-tehnicheskoye obespecheniye as combat service support.[b]
- Rear or rear area support (*tyl*): "A part of the Russian Armed Forces which includes forces and means intended for the rear and rear services technical support of troops in peace- and war-time."[c]
- Material-technical means (*materialno-tehnicheskiye sredstva*): "The means that troops need to live and fight." They include food, clothing, ammunition, small arms, artillery, tanks, and armored vehicles.[d]
- Engineering and airfield support (*inzhenerno-aerodromnoye obespecheniye*): "A set of measures aimed at preparing and maintaining airfields in constant readiness for operation in peacetime and wartime, ensuring combat readiness, survivability of aviation and the safety of its flights; type of rear support."[c]
- Logistics (*logistika*): "The theory of planning, management and control of the processes of movement of material, labor, energy and information flows in human-machine systems." A loan-word that is less used in the military domain.

SOURCES:

[a] Ministry of Defense of the Russian Federation, "Materialno-Tehnicheskoye Obespecheniye Vooruzhennih Sil Rossiiskoi Federatsii."

[b] Myyryläinen, "Venäjän Asevoimien Materiaalitekninen Huolto Maa-Voimien Tukemisessa - Nykytilanne Ja Kehitysnäkymiä Kohti 2040-Lukua." See also Ministry of Defense of the Russian Federation, "Combat Service Support in the Russian Armed Forces."

[c] Ministry of Defense of the Russian Federation Encyclopedia, "Inzhenerno-aerodromnoye obespecheniye."

[d] Adapted from Akademik.ru, "Kratkii Slovar Operativno-Takticheskih I Obshevoyennih Terminov. Materialno-Tehnicheskiye Sredstva."

NOTES: Other terminology is also used, especially pertaining to the technical implementation of logistics and maintenance. Examples include rear area support (tilovoye obespecheniye), maintenance (obsluzhivaniye), and provision (snabzheniye). Some Russian terms might overlap with each other.

Russia's Material-Technical Support System

Organizational Structure and Functions

The Russian Armed Forces' MTO system has a strictly vertical hierarchy. The general manager of the system is the Deputy Minister of Defense of the Russian Federation. This individual exercises control through the Headquarters of Logistics of the Armed Forces, which comprises three departments (resource, transport support and operational maintenance, and utilities), three main directorates (armored vehicle, rocket-artillery, and Railway Troops), and three administrative departments (*upravleniye*) (metrology, memory of those who have perished in defense of Russia, and monitoring of the material-technical sustainment system).[5]

The management of MTO within Armed Forces, military districts and fleets, and large formations is carried out by the respective deputy commanders-in-chief for material-technical support. As of 2020, Russia claimed to have approximately 160,000 military personnel and more than 145,000 civilian personnel (or a ratio of one sustainer to every five combat personnel) involved with MTO tasks across the Armed Forces.[6] The general management of support is carried out by several military bodies under the Deputy Minister of Defense.[7] These high-level bodies are mainly engaged in planning of sustainment, execution of control of sustainment troops, legal regulation, and organization of training. This structure is represented in Box 2.

Russia operates a predominantly push-logistics system where resources are "pushed" forward to the fighting units often using predetermined consumption rates and prior planning, often done by the higher echelon of command (such as the General Staff) months before the start of a conflict.[8] This system is generally viewed as benefiting operations where the usage of materiel is relatively predictable and stable.[9] Although pull-based logistics is a more flexible, decentralized demand-based system, the more rigid push-based system works best in cases where demand can be easily estimated and stabilized.[10]

Although a detailed structure of the contemporary MTO is not available, Russian authors tend to speak of the Russian military MTO system in terms of subsystems. Although there are differences in how Russian authors approach the MTO system, and the thinking has evolved over time along with Russia's military reforms, some of the latest publications detail three large subsystems: (1) general maintenance, (2) technical maintenance, and (3) specialized material-technical maintenance (MTM).[11] In addition to these subsystems, it is also possible to distinguish between stationary forces and equipment, and mobile forces and equipment.

BOX 2

Structure of the Central Office of the Material-Technical Organization of the Armed Forces of Russia

- MTM Headquarters of the Armed Forces of the Russian Federation
- Department of Transport Support of the Ministry of Defense
- Food Administration of the Ministry of Defense
- Clothing Department of the Ministry of Defense
- Department of Operational Maintenance and Provision of Public Services for Military Units and Organizations of the Ministry of Defense
- Main Armored Directorate of the Ministry of Defense
- Main Rocket and Artillery Directorate of the Ministry of Defense
- Main Directorate of the Chief of the Railway Troops
- Metrology Department of the Russian Armed Forces
- Department of Rocket Fuel and Fuel

SOURCE: Ministry of Defense of the Russian Federation, "Materialno-Tehnicheskoye Obespecheniye Vooruzhennih Sil Rossiiskoi Federatsii."
NOTE: Medical support does not belong to MTM.

Troop mobility has been key for achieving success in the armed conflicts of the 20th and 21st centuries.

Stationary logistics and sustainment include a wide variety of services that support military units during their daily peacetime activities, which include MTO centers, housing and communal facilities, central reserve bases, metrology centers, veterinary and sanitary expertise, and environmental centers. Mobile support components are particularly relevant for operational use but can also be used in peacetime. They include material-technical sustainment brigades, separate railway brigades, technical missile bases, separate repair and evacuation regiments, repair and evacuation battalions, and support vessel groups.[12]

Recent MTO Reforms

In 2010, Russia introduced the Unified System of Material and Technical Support (*Yedinaya Sistema Materialno-Tehnicheskovo Obespecheniya*) as part of the "New Look" military reforms that occurred in 2008. The aim of these reforms was to make the Russian forces leaner and more efficient, with the brigade replacing the division as the primary tactical unit, and eliminating partially manned divisions designed to be filled with conscripts.[13] The reform aimed to address such MTO problems as high fragmentation of MTO-related functions across different government bodies and ministries, ineffective resource management, and inefficient procurement systems.[14] The purpose of the new unified system was to improve combat readiness by building a vertically integrated system, where

> structures designed to provide the Armed Forces with all types of materiel, organize the operation, maintenance and repair of weapons and military equipment, carry out military transportation by all modes of transport and maintenance of transport communications and facilities [are unified under single command].[15]

It sought to unify the two existing sides of MTO—technical support and rear area support.[16]

The reforms also included a pivot toward outsourcing more services, from catering and laundry to weapons servicing and repair—specifically through Oboronservis, an open joint stock company, and its subholding companies.[17] Mobile repair brigades were being formed to "free the commander from the problems associated with maintenance of weapons, and military and special equipment," free up the troops from "non-core" activities, and make maintenance and repair less dependent on conscripts.[18] Russia has been moving away from carrying large amounts of military equipment as a reserve and improving the dire state of its obsolete warehouses. Instead, it is consolidating the warehouses into large, newly created logistics centers. One such center is the Nara logistics complex in the city of Naro-Fominsk near Moscow, which reportedly can store 2,000 units of equipment and material from 17 bases and warehouses.[19]

Troop mobility has been key for achieving success in the armed conflicts of the 20th and 21st centuries. Thus, the use of only one type of transport mode would not ensure the ability to carry out transportation tasks in a timely manner. Some Russian authors argue that "the achievement of success in fulfilling the tasks of the logistics of troops will be based on the integrated use of various modes of transport."[20] Although Russia is heavily dependent on railway for extended-distance transport within the country, it has improved its ability to move heavy and oversized goods within its territory by road.[21] One such example is the entry into force of the law entitled "On Amendments to the Articles 31 and 31.1 of the Federal Law on Highways and Road Activities in the Russian Federation and on Amendments to Certain Legislative Acts of the Russian Federation" in

2016, which alleviates the movement restrictions on military equipment.[22]

Although I largely focus on ground forces in this report, Russian Aerospace Forces also offer a pertinent study of problems and challenges in the Russian military logistics and sustainment system. The Logistics Department of the High Command of the Aerospace Forces was created only following the sweeping military reforms of the early 2010s, which resulted in the creation of the new Aerospace Forces by merging the previously separate Air Force and Aerospace Defense Forces. Although this department represents an attempt to centralize Aerospace Forces' logistics and sustainment, logistics services were also included in the staff directorates of the commands of the branches of the Aerospace Forces (the Air Force, Air and Missile Defense Force, and the Space Force). However, the development of the Aerospace Forces MTO is still ongoing—the *Concept of Construction and Development of the Aerospace Forces Until 2025* report still envisages additional reforms of the tasks and management of the MTO system—such as the inclusion of military repair shops in Aerospace Forces formations and the creation of 13 repair platoons to improve the ability to carry out medium and current repairs of equipment and weapons.[23] The Aerospace Forces are also in the middle of equipping airfields with airfield engineering equipment and modern means of supporting aviation flights to ensure that at least 57 percent of the aviation flight support means are modern, which is expected to reduce accidents related to aircraft engine failure and increase the efficiency of airfield operational units by 30 percent. Russia is also reportedly modernizing the existing stationary refueling complexes in 43 airfields with the aim to reduce refueling time. One of the priority areas for the Aerospace Forces MTO Department is ensuring the fire safety of military infrastructure and units. Russian government sources state that, within the recent years, Aerospace Forces have been fully equipped with the necessary fire safety equipment.[24]

MTO in Exercises

MTO training is often conducted as special exercises prior to the major Military District exercises and as part of Collective Security Treaty Organization (CSTO) exercises. In 2020, for example, Russian forces reportedly carried out 168 events aimed at improving the operational readiness of the MTO troops. Three of these exercises—operational mobilization of the Russian forces leadership, strategic command and staff training for the Armed Forces leadership, and a joint command-staff exercise with the Military Academy of the General Staff of the Armed Forces—were at the Chief of General Staff–level.[25]

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In 2021, Russia reportedly increased the intensity of MTO training and education, carrying out more than 1,000 training events, which culminated in a special exercise of MTO forces of the Western Military District and the Northern Fleet. The joint strategic exercise Zapad-2021, for example, included a broader MTO exercise that took place across 11 training grounds of the Military District and involved more than 400 units and trained logistics support management for "strategic operation," and operations against the notional adversary of "illegal armed groups," and "strategic operation." Also, during Zapad-2021, for the first time, was the deployment of a mobile repair and recovery train.[26] Furthermore, in 2018, the repair unit deployed to the Russian base in Abkhazia conducted a drill of the evacuation of military equipment damaged under enemy fire using BREM armored recovery vehicles.[27] Other exercises have included such elements as landing support for tank units; mass refueling; and delivery of ammunition, fuel, and other material via aerial delivery.[28]

According to the Transparency International Government Defense Integrity Index 2020, the overall risk of corruption in Russian defense and security institutions is high.

Russia has also sought to improve international coordination by carrying out MTO-focused exercises with Belarus via the Regional Grouping of Forces (*regionalnaya gruperovka voisk*) and the Collective Rapid Reaction Force of the CSTO during its exercise Echelon-21.[29] MTO units have previously participated in other CSTO exercises, such as Indestructible Brotherhood (*Neruzhimoye Bratstvo*), Interaction (*Vzaimodeistviye*), Indra, Selenga, Defenders of Friendship (*Zashitniki Druzhbi*), Laros, and Friendship (*Druzhba*).[30]

Despite their benefits, MTO exercises have also revealed some sustainment challenges across Russian forces. For example, the MTO exercises carried out in 2017–2019 showed that separate fueling companies (*otdelnaya rota zapravki garyuchim-orzg*) do not have adequate weapons to repel an attack, that the existing refueling stations are obsolete, and that "there are no technical means to ensure stable communications between the commander of the refueling company and commanding officer or effective interactions within the company itself."[31] Furthermore, there was a lack of equipment necessary to repair special fueling equipment and uniform requirements for how the separate refueling companies are deployed for mass refueling needs.[32]

Problems and Challenges of Russia's MTO System

Shortly before 2022, Russian authors and the few Western authors writing about the topic were divided in their assessment of Russian military MTO capabilities. Although some were cautiously optimistic, others lamented numerous persistent problems, even claiming that

> the existing logistical support system does not fully meet modern requirements, thus it can reduce the effectiveness of the use of a group of troops (forces) and doom the tasks to failure, frustrate the decisions of the political leadership of the country.[33]

Indeed, many of the challenges to Russian logistics surfacing today had been identified by Russian experts writing in professional journals prior to 2022.[34] These challenges include such broader systemic issues as resource inefficiency in the military and the defense industry; inadequate warehousing for fuel, lubricants, and food; and unsuccessful, partially implemented, or ongoing reforms in military logistics and sustainment (including attempts to outsource certain services).[35] Russian Aerospace Forces' engineering and airfield support services have been falling behind in the areas of air base security, modern protective shelters for air capabilities, capacity to carry out airfield camouflage tasks, and basic repair services.[36] A high percentage of airfield maintenance equipment (such as airfield watering and thermal ice machines) are aged, and some of the equipment is no longer produced. Authors also admit that the operation of temporary airfields is complex, resource intensive, and further hampered by the fact that most airfield equipment would need to be transported at low speeds via rail or waterways due to their size.[37]

Various open-source reports and arrests suggest that corruption is the source of some of these problems.[38] Over the past seven years, several Ministry of Defense and Ministry of Industry and Trade officials have been detained or arrested for corruption.[39] According to the Transparency International Government Defense Integrity Index 2020, the overall risk of corruption in Russian defense and security institutions is high.[40] Corruption, along with the

secrecy associated with supply and equipment data, might have made it more difficult to estimate actual Russian military power even in Russia.[41]

Continuous problems in Russian military MTO and unsuccessful or partially implemented reforms might have prevented the Russian military logistics system from responding to the rapid change in the Ukrainian tactics and the consequent change in support demands. As of 2017, the existing food supply system was not well-prepared for a potential local war or military conflict, and food stocks in contractors' warehouses were not clearly marked.[42] A 2018 article reported about 400 obsolete warehouses and problems with the delivery of spare parts to the military units dispersed across Russia. To address these issues, a warehousing reform has been underway for the past several years, aiming to create more-technologically-advanced and automated storage complexes.[43] However, these improvements might have come too late or too slow and lacked proper execution and oversight.

The broader military reforms in Russia—such as the changes in the composition of troops (forces)—might have reduced the average resource needs in operations. But it might have also undermined the Armed Forces' capabilities to deliver goods by road. The elimination of automobile brigades (*avtomobilniye brigadi*) and reductions in the number of automobile battalions (*avtomobilniye batalyoni*) in military districts and fleets have also likely contributed to distribution problems. Furthermore, the Armed Forces lost some of its cargo loading and unloading operations capabilities, which are available only at stationary logistics and technical support centers. During peacetime, MTO brigades and logistics support battalions did not have full-time cargo loading and unloading units.[44]

As of 2020, organizational reforms may not have solved coordination issues among the many different actors involved in the supply of troops in crisis. "Objects of military economy" (e.g., a canteen) only nominally has one owner, but in practice "live[s] according to different laws, are financed from different services, and are subordinate to at least two structures."[45] Other reports suggest inadequate and slow allocation of funding for material technical sustainment and burdensome nomenclature and distribution of spare parts. According to Russian authors advocating for better automation and digitization of logistics processes, low levels of digitization and automation of logistics and sustainment could be costing as much as 40 percent of work time in Russian air defense units.[46]

The attempts to seek efficiency through outsourcing such services as vehicle maintenance and catering resulted in uncertain success.

Challenges During Recent Deployments

Russian experts have analyzed previous Soviet and Russian military engagements from the perspective of MTO security. Indeed, some of the challenges seen in Ukraine are reminiscent of challenges that Russians encountered in Georgia in 2008,[47] such as poor organization and communication among units and key logistics nodes and, perhaps even more importantly, an insufficient degree of awareness among the rear management bodies of the upcoming tasks and the level of unpredictability of adversary actions.[48]

Although the experience in the Russo-Georgian War accelerated the overarching military reforms initiated by Minister of Defense Anatoly Serdyukov,[49] many of these issues were known and not sufficiently addressed from the mid-2000s to 2022 despite organizational or doctrinal reforms or ad hoc approaches prior to the beginning of Russia's invasion of Ukraine in February 2022. The attempts to seek efficiency through outsourcing such services as vehicle maintenance and catering resulted in uncertain success. Some Russian authors lament the lack of motivation

of private companies to properly maintain fixed assets; others were concerned about the readiness of the military food supply system to provide for wartime scenarios and the state of food restocking in military warehouses.[50]

Although the more recent deployments to Syria and Nagorno-Karabakh did not pose the same logistical burden on MTO as did the requirements in Ukraine (detailed further in Box 3), the experience did prove "that the issues of material and technical support (MTO) of the troops (forces) are of paramount importance and determine the success of the operation."[51] Russia's deployment to Syria is often highlighted as a logistical success, largely because it was an unprecedented experience in expeditionary operations. But the Syrian experience also illustrates some of the limits of its MTO system—specifically how challenging it is for Russia to sustain large-scale operations far beyond its borders.[52] Furthermore, Russia was dependent on air and maritime transport, and operations did not include land-based movement.[53]

The largest expeditionary military deployment undertaken by the Russian forces—its ongoing military operation in Syria—has fewer lessons for the ground forces and might be less applicable to ensuring success in Ukraine.[54] First, the mission in Syria was highly dependent on Russia's ability to provide air and sea-based transport—sometimes called the "Syrian Express." Russian forces used military air transport when quick transfers to Syria were necessary.[55] But it struggled to deliver supplies via maritime routes due to the lack of vessels in the Russian Navy.[56] Not only did Russia have to resort to using its military landing ships in the absence of modern carriers, it also scrambled to purchase large civilian transport ships from Ukraine, Turkey, and Greece.[57] Second, repairs and maintenance works were carried out by both military and defense industrial teams in support of Russian and Syrian forces, and these repair locations were removed from active hostili-

BOX 3

Vignette: Military Movement Challenges in Nagorno-Karabakh

Russia's peacekeeping deployment to Nagorno-Karabakh in 2020 was relatively small (1,960 troops, supported by 90 armored vehicles and 380 other vehicles and technical equipment). With a 400-person MTO group and a main camp, this deployment was fixed and, unlike the operations in Ukraine, had no requirement for opposed force battle and mobility. However, the Nagorno-Karabakh deployment did offer some lessons about the transportation of more-difficult cargo, such as armored vehicles. The cargo that traveled by train was delivered to the Barda station in Azerbaijan where it had to be transported 73 km by road to Stepanakert, where the Russian headquarters was located. Problems that had to be overcome included making service payments to Azerbaijan in its currency, getting through Azerbaijan's customs procedures, and road transportation in challenging geographical conditions (e.g., winding mountain roads, hot climates).

Road transportation was carried out by an automobile company and a material sustainment company, and three support platoons, with the reported capacity to transport more than 1,200 tons of material a day (which included 992 tons of dry cargo, 174 tons of bulk cargo, and 42 tons of water). Refueling was done via container-based filling stations, except for remote posts, where it was dependent on R-4 tanks and KR-40 fuel dispensers. In addition to ensuring the necessary material for daily operations, the MTO group also created reserves that would be able to support one month of autonomous deployment operations. Technical support to vehicles was carried out by the forces of the repair company and platoon and the maintenance departments (*otdeleniya*) of the maintenance platoons of the motorized rifle battalions. Their reported repair capacity was up to three armored vehicles or up to 11 vehicles a day.

SOURCES: Demin and Khlebnikov, "Material'no-Tekhnicheskoye Obespecheniye Mirotvorcheskogo Kontingenta V Nagornom Karabakh"; Vartanyan, "A Risky Role for Russian Peacekeepers in Nagorno-Karabakh"; and Smurov, "Tekhnicheskiy I Sotsial'nyy Aspekty Material'no-Tekhnicheskogo Obespecheniya Voysk (Sil)."

NOTES: Four mobile repair teams were allocated to conduct daily technical support at observations posts. Repair services were also provided by the industry.

ties. Third, instead of pushing forward MTO support behind advancing troops in Syria, Russia was employing a more unusual approach for its military tradition and was proactively building support in front of the forces due to the large distance between Syria and Russia and the lack of a shared border. Indeed, the example of Syria is particularly interesting from the point of view of Russian Aerospace Forces. Russian sustainers had to ensure the delivery of supplies prior to the arrival of the Russian military aviation to the Khmeimim Air Base in 2015. Furthermore, the Russian Aerospace Forces adopted at least one lesson from its Syrian experience: the use of a centralized refueling system that allowed the refueling of multiple aircraft simultaneously. In 2017, Russian general Dmitry Bulgakov claimed that Russia's aim is to install such systems in 68 facilities in Russia and ensure the ability to refuel 800 aircraft simultaneously.[58]

Russian war planning includes calculations of potential resource consumption (*rashod resursa*) during combat. The purpose of such formulae is to approximate how many resources the forces will need and better understand the need for technical support, the time and place of resource replenishment, and the potential requirement for repair services.[59] Prior to the Russia-Ukraine War of 2022, some Russian authors offered assumptions and critiques of how a Russian military logistics system would perform in the case of a crisis or war. Although many sources applaud numerous achievements in the MTO system, some offer a more sobering perspective. An article published by a retired and an active duty officer in 2018 claimed that the MTO systems of military districts and fleets might not be able to support the kind of operational exchange of information, automation, and survivability that would be needed in wartime conditions.[60] These Russian authors urged development of new methods of calculating the operational need for material resources if a predominantly push-based logistics system is continued.

Developing these new methods could prepare the Russian forces for "modern conditions, when hostilities will have a highly maneuverable character" and traditional MTO management approaches might be insufficient.[61] Furthermore, the lessons from the Russo-Georgian War showed that these calculation methods might not be adequate for wartime purposes.[62]

In conclusion, Russian experts were well aware of the many problems in the MTO system. However, it is unclear to what extent military decisionmakers applied the analysis and solutions proposed by the research community or the lessons learned from previous military engagements.[63] Although Russian forces have been working on solving some of its MTO issues, it is likely that most of them were still in process at the time of Russia's invasion of Ukraine in February 2022. Furthermore, it could also be likely that during the military capability reform process of the past ten years, Russia overlooked the importance of, or simply skimped on, investing in the development of robust MTO enablers, while initiated changes might have been burdened by mismanagement and corruption.[64]

Insights from the 2022 Russia-Ukraine War

It is inherently challenging to analyze an ongoing war because of the lack of available detailed information. Therefore, the insights presented here are only preliminary and characterize only some of the factors that might have affected Russian performance during the first months of the expanded war between Russia and Ukraine from February to May 2022, when longer-range Western weapons were delivered to Ukraine.

The primary reason for Russia's initial logistical problems in Ukraine seems to have been fundamental flaws in the operational design. The initial Russian scheme appeared to have been built on assumptions that Ukrainian forces would offer minimal resistance and that considerable risk could be accepted in terms of the security of ground forces and their lines of communications. Russia's push-logistics system has a higher risk of underperforming when the predicted level of resistance is wildly wrong. Given more time to prepare and a more accurate understanding of the challenge, some sustainment aspects of the campaign might have gone differently. Furthermore, as Russian experience in Georgia demonstrated, inefficient exchange of operational

The plan itself did not facilitate the employment of key capabilities that would have allowed combat units to transition more effectively to offensive operations against a resisting adversary.

information between the deployed units and the rear area due to technical and human errors could further hamper access to adequate levels of supplies.[65] From the point of view of logistics and sustainment, Russia probably made its most significant advances during the earlier stages of war in South Ukraine from occupied Crimea at least partially because of the higher-quality sustainment capabilities available from Crimea, including via rail.[66]

A second problem for Russian logistics is related to force employment. The extreme secrecy under which the initial plan was developed meant that many Russian units did not have much time to prepare for operations, including ensuring coordination among the different actors involved in Russian military logistics, which undermined their ability to adjust to battlefield circumstances.[67] Prewar, some Russian authors stated that logistics can only be successful through "close interaction between the supplying authorities, organizations of the military-scientific complex, and enterprises of the military-industrial complex of the Russian Federation."[68] This degree of coordination likely did not happen. In many cases, combat units received less than 24 hours' notice before the start of operations, despite a good number of those units having been postured near Ukraine for weeks and even months.[69] The plan itself did not facilitate the employment of key capabilities that would have allowed them to transition more effectively to offensive operations against a resisting adversary.

Another serious challenge has been the sheer scale of the Russian force committed to operations. All of Russia's major land force formations contributed to the initial operation, and most of the remaining nonconscript forces were committed after the initial invading forces were decisively engaged. Russian plans have generally assumed that large wars would involve a large-scale mobilization of the country, including the commitment of conscript soldiers.[70] The attempt to achieve large-scale objectives in a special military operation without corresponding mobilization during the first five months has certainly posed challenges for material-technical support units, which are staffed with conscript soldiers that are not (legally) permitted to directly participate. Deployments of the size seen in the Ukraine campaign also rely on Russia's rail network. Although railways within Russian territory seem to have served as a reliable means of transport, they faced local sabotage attempts in Belarus.[71] Russia's likely plan to establish the Hostomel airport near Kyiv as a logistics hub for operations against Kyiv failed as a result of Ukrainian defensive operations, seemingly with little to no Russian contingency plans. Russia's inability to gain dominance of the Ukrainian rail network might have undermined some of its military aims, such as the failed approach to Kyiv.[72]

Considering that Russian military manuals describe in detail the potential threats during military movement in wartime conditions and how to defend against them, and its own interest in unmanned aerial vehicles (UAVs), the reported lack of convoy protection, particularly against sensors and UAVs seemed surprising.[73] The reasons for this, again, seem to be the inadequate assumptions about the operational environment. In the initial phase of the operation, Russian forces achieved impressive early gains in some areas by pushing along routes that were not well defended, but then found that attacks on unprotected rear areas forced them to stop to recover, and in some cases even to double back to secure their lines of communication. In the case of

Russia's 4th Tank Division, as many as one-third of the tanks committed from the two tank regiments of the division might have been abandoned due to a lack of fuel.[74] This case might be an outlier—the T-80U tanks used in these regiments are powered by a gas turbine and have unusually high fuel consumption—but is illustrative of problems of rapid movement without effective rear area security.

Russian battalion tactical groups are usually built around vehicles that have a relatively large fuel reserves (500 km), and by doctrine they carry two full refills of fuel in tankers that accompany them.[75] However, these groups will need resupply in four to five days and likely sooner when engaged in high-intensity combat. High-bandwidth fuel resupply is provided via flexible pipelines over short distances that do not seem to have been built in Ukraine.[76] Beyond that, fuel is transported in tankers, which were an early target of Ukrainian infantry, artillery, and armed drones, and, in some cases, tankers had to deal with traffic congestion along main supply routes to reach forward forces.[77]

Russian ammunition supplies have also not been well protected. Russian artillery ammunition has not benefited from recent innovations in insensitive propellants and explosives, so stockpiles that are not in protected positions have tended to detonate when attacked.[78]

In the second major phase of the 2022 conflict starting at the beginning of April, Russia consolidated its efforts to the Donbas region and operated at a much slower pace but with a higher rate of ammunition consumption. Russia's reliance on cannon and rocket artillery for fire support has meant that a considerable portion of its logistics enterprise has to be devoted to ammunition transport and handling. The sheer space and weight of this ammunition, particularly rocket artillery projectiles, is enormous. A single battalion salvo of 128 220-mm rockets weighs over 38 short tons.[79] Reloading the launchers—which in all Russian systems is still done with one single rocket at a time—requires special vehicles (for the heavier rocket types) and a stockpile of rockets, which can come in numerous varieties.

Russia's reliance on cannon and rocket artillery for fire support has meant that a considerable portion of its logistics enterprise has to be devoted to ammunition transport and handling.

Conclusion

The analysis included in this report was finalized in January 2023. At the time of writing, Russian authors had not published a detailed analysis of Russia's logistics and sustainment in the ongoing war with Ukraine because discussing many topics pertaining to the war had effectively been criminalized with new laws. However, some sources offer snippets of emerging lessons learned in the research community. One such lesson is the large-scale use of UAVs, which leads to faster movement of fighting units; the need to adopt better camouflage; an overall reduction of tactical actions; and a requirement for the fighting units to have more-mobile support systems.[80] Other recent articles have made some references to the potential impact of sanctions on force and MTO structure and MTO optimization. Some authors call for the adoption of active defense, which would entail "advanced deployment of the MTO system"—prepositioning of weapons and military equipment, advance preparation of MTO areas, and the preparation of state structures and commercial organizations of the host country.[81] These last suggestions, however, are likely based more on the experience in Syria and exercises rather than the ongoing war in Ukraine.

Notes

[1] Garamone, "Ukrainian Resistance, Logistics Nightmares Plague Russian Invaders"; Ti, "Russian Military Logistics"; "Why a Huge Russian Convoy Remains Stalled North of Kyiv."

[2] Human Rights Watch, "Russia Criminalizes Independent War Reporting, Anti-War Protests."

[3] Adamsky, "Continuity in Russian Strategic Culture: A Case Study of Moscow's Syria Campaign."

[4] Ministry of Defence of the Russian Federation, "Materialno-Tehnicheskoye Obespecheniye Vooruzhennih Sil Rossiiskoi Federatsii."

[5] Ministry of Defence of the Russian Federation, "Sovremennoye sostoyaniye i perspektivy razvitiya sistemy material'no-tekhnicheskogo obespecheniya Vooruzhennykh Sil Rossiyskoy Federatsii."

[6] Ministry of Defence of the Russian Federation, "Sovremennoye sostoyaniye i perspektivy razvitiya sistemy material'no-tekhnicheskogo obespecheniya Vooruzhennykh Sil Rossiyskoy Federatsii."

[7] The procurement of material-technical means for troops is carried out through centralized procurement agencies and distributed according to centralized distribution volumes. Pulinets and Sinkevich, "Logistika V Material'no-Tekhnicheskom Obespechenii Voysk."

[8] Paché, "Attaque Russe Contre l'Ukraine: Des Revers Logistiques Encore Mal Appréhendés."

[9] Ti, "Russian Military Logistics."

[10] Paché, "Attaque Russe Contre l'Ukraine: Des Revers Logistiques Encore Mal Appréhendés."

[11] Myyryläinen, "Venäjän Asevoimien Materiaalitekninen Huolto Maa-Voimien Tukemisessa - Nykytilanne Ja Kehitysnäkymiä Kohti 2040-Lukua."

[12] Ministry of Defence of the Russian Federation, "Sovremennoye sostoyaniye i perspektivy razvitiya sistemy material'no-tekhnicheskogo obespecheniya Vooruzhennykh Sil Rossiyskoy Federatsii."

[13] Lennon, "Russia's New Look Army Reforms and Russian Foreign Policy."

[14] Other problems that were reported prior to the 2010 reforms include a high rate of Russian military aviation accidents, with 11 accidents reported in 2008. The reasons that Russian authors report include training problems, lack of timely and objective assessment of the technical condition of aircraft, inadequate repairs, and even the use of counterfeit parts (and parts of "dubious origin") in repairs. Mikhailov, "Yedinoi Sisteme Tilopvovo Obespecheniya," pp. 19–22; Baynetov, "Obespecheniye Bezopastnosti Problemi I Ih Reshen," pp. 22–25.

[15] Note that at least some Russian authors criticized the reform for blindly "copying Western standards and approaches of creating support systems without thorough verification of their compliance with Russian realities and the directions of military development." Sherbakov, "Materialno-Technicheskoye Nedrazumeniye"; Maligin, "Yedinaya Struktura MTO Proshla Proverku Boyen"; Ministry of Defense of the Russian Federation Encyclopedia, "Inzhenerno-aerodromnoye obespecheniye"; Ministry of Defence of the Russian Federation, "Istoriya Razvitiya I Stanovleniya Sistemi Materialno-Tehnicheskovo Obespecheniya Vooruzhennih Sil Rosiiskoi Federatsii."

[16] "Transition to a Unified System of Logistics of the Armed Forces."

[17] This was done with the intention that Oboronservis would service the needs of the Armed Forces both in peacetime and in wartime. See "Transition to a Unified System of Logistics of the Armed Forces."

[18] "Transition to a Unified System of Logistics of the Armed Forces."

[19] Ministry of Defence of the Russian Federation, "Sovremennoye sostoyaniye i perspektivy razvitiya sistemy material'no-tekhnicheskogo obespecheniya Vooruzhennykh Sil Rossiyskoy Federatsii"; Oknastar, "Proidvodstevvo-Logisticheskii Komplek 'Nara.'"

[20] Pulinets and Sinkevich, "Logistika V Materialno-Tekhnicheskom Obespechenii Voysk." See also Vinogradov et al., "Sovershenstvovaniye Tekhnicheskogo Osnashcheniya I Organizatsionno-Shtatnoy Struktury Otdel'noy Roty Zapravki Goryuchim."

[21] In 2018, 87 percent of transportation services were done by rail and only 9 percent by road. Beysenbaev and Dus, "Russia's National Logistics System: Main Directions of Development."

[22] Buravtsev, "Ostorozhno: Opasnyy Gruz." See also Russian Federation, "Federal'nyy Zakon O Vnesenii Izmeneniy V Statyi 31 I 31.1 Federalnovo Zakona "Ob Avtomobilnykh Dorogakh I O Dorozhnoy Deyatelnosti V Rossiskoy Federatsii I O Vnesenii Izmenenii V Otdelniye Zakonodate'niye Akty Rossiyskoy Federatsii.""

[23] Kheirbekov, "Materialno-Tehnicheskoye Obespecheniye Vozhdushno-Komicheskih Sil: Vzhera, Segodnya, Zavtra."

[24] Kheirbekov, "Materialno-Tehnicheskoye Obespecheniye Vozhdushno-Komicheskih Sil: Vzhera, Segodnya, Zavtra."

[25] Muminjanov, "Bez Zaderzhek I Sryvov Obespechivayutsya Voyska Prodovol'stviyem, Toplivom I Veshchevym Imushchestvom."

[26] Shutov, "Remontniki Na Pole Boya."

[27] "Materialno-Tehnichenicheskoye Obespecheniye."

[28] Pichugin, "Special Logistics Exercise in the Southern Military District."

[29] In 2021, the CSTO member states signed the Agreement on Joint Material, Technical, and Medical Support of the CSTO Troops (Collective Forces). Smurov, "Tekhnicheskiy I Sotsial'nyy Aspekty Material'no-Tekhnicheskogo Obespecheniya Voysk (Sil)."

[30] Muminjanov, "Bez Zaderzhek I Sryvov Obespechivayutsya Voyska Prodovol'stviyem, Toplivom I Veshchevym Imushchestvom."

[31] Vinogradov et al., "Sovershenstvovaniye Tekhnicheskogo Osnashcheniya I Organizatsionno-Shtatnoy Struktury Otdel'noy Roty Zapravki Goryuchim."

[32] Vinogradov et al., "Sovershenstvovaniye Tekhnicheskogo Osnashcheniya I Organizatsionno-Shtatnoy Struktury Otdel'noy Roty Zapravki Goryuchim."

[33] Myyryläinen, "Venäjän Asevoimien Materiaalitekninen Huolto Maa-Voimien Tukemisessa - Nykytilanne Ja Kehitysnäkymiä Kohti 2040-Lukua"; Stulov and Lyskan, "Resheniuye Problemi Nacionalnoi Bezopastonti V Cherezvichainih Usloviyah Za Predelami Rossiiskoli Federacii Putem Vnedreniya Perspektivnoi Voyennoi Logisticheskoi Sistemi."

[34] See, for example, Stulov and Lyskan, "Resheniuye Problemi Nacionalnoi Bezopastonti V Cherezvichainih Usloviyah Za Predelami Rossiiskoli Federacii Putem Vnedreniya Perspektivnoi Voyennoi Logisticheskoi Sistemi."

[35] Koleyho and Hrustalev, "Spvershenstovaniye Sistemi Prodovolstvonnovo Obespecheniya Rosiiskoi Armii V Sovremennih Usloviyah"; Kalii, "A Nachalos S Proviantiskih Skladov"; Zhukovskii and Gagarin, "Aktualnost Logicheskovo Podhoda K Organizacii Materialo-Tehnicheskovo Obespecheniya Voinskih Chastei MO"; Council of the Federal Assembly of the Russian Federation, "Unificirovannaya Sistema Tilovovo Obespecheniya: Voprosov Bolshe, Chem Otvetov."

[36] Borodin, Samusenko, and Lazukin, "Metodologicheskii Podhod K Resheniyu Problemi Obosnovaniya Trebovanii K Sisteme Inzhenerno-Aerodromnovo Obespecheniya Boyevih Deistvii Aviatsii BBS," pp. 867–875.

[37] Bytkovsky, "Problemi Tehnicheskoi Osnashennosti Podrazdelenii Inzhenerno-Aerodromnovo Obespecheniya V Sostave Mobilnih Komendatur."

[38] Trifanov, "Vzyatka Za Licensiyum."

[39] Mashkin, "Kapustin Yar Was Cleansed from Fuel Oil and Corruption."

[40] Transparency International, "Government Defence Integrity Index 2020."

[41] One source notes that although Russia's military spending may be substantial, "These are all impressive figures, of course, but we, I mean society and experts, often do not understand at all what this money is spent on, we do not have any opportunities to control, to check these expenses" (Organized Crime and Corruption Reporting Project, "Samii Nadezhnii Soyuznik. Kak Korruptsiya V Rosiiskoi Armii Mozhet Spasti Ukrainu").

[42] Koleyho and Hrustalev, "Spvershenstovaniye Sistemi Prodovolstvonnovo Obespecheniya Rosiiskoi Armii V Sovremennih Usloviyah"; Ignatenko, Naconov, and Pahomov, "Povisheniye Effektivnosti Sistemi Prodovolstvennovo Obespecheniya Voyennoi Organizatsii Gosudarstva V Usloviyah Importozamesheniya."

[43] Zhukovskii and Gagarin, "Aktualnost Logicheskovo Podhoda K Organizacii Materialo-Tehnicheskovo Obespecheniya Voinskih Chastei MO"; Kalii, "A Nachalos S Proviantiskih Skladov."

[44] Serba and Grachev, "Problems and Directions of Improving the System of Material and Technical Support of the Armed Forces of the Russian Federation."

[45] Kortyn, "The Rear Should Be United."

[46] Brezhnev and Kalachnikov, "Problemnyye Voprosy Avtomatizatsii Upravleniya Tylovym Obespecheniyem Chastey I Soyedineniy PVO."

[47] Naumov, "Opit Organizacii Upravleniya Tilom Rossiiskovo Kontingenta V Zonah Gruziino-Osetinskovo I Gruzino-Abhaznovo Konfliktov."

[48] Koleyho and Hrustalev, "Spvershenstovaniye Sistemi Prodovolstvonnovo Obespecheniya Rosiiskoi Armii V Sovremennih Usloviyah."

[49] Myyryläinen, "Venäjän Asevoimien Materiaalitekninen Huolto Maa-Voimien Tukemisessa - Nykytilanne Ja Kehitysnäkymiä Kohti 2040-Lukua."

[50] Ignatenko, Naconov, and Pahomov, "Povisheniye Effektivnosti Sistemi Prodovolstvennovo Obespecheniya Voyennoi Organizatsii Gosudarstva V Usloviyah Importozamesheniya"; Koleyho and Hrustalev, "Spvershenstovaniye Sistemi Prodovolstvonnovo Obespecheniya Rosiiskoi Armii V Sovremennih Usloviyah."

[51] Akimov and Zhernakov, "Deystvuya Na Operatsiya. Razvitiye Tekhnicheskoy Obespechennosti Sistemy Material'no-Tekhnicheskogo Obespecheniya – Zalog Boyesposobnosti Vooruzhennykh Sil Rossiyskoy Federatsii."

[52] Grady, "Expert: Syria Deployment Pushing the Limits of Russian Military Capability."

[53] Lavrov, *The Russian Air Campaign in Syria: A Preliminary Analysis*.

[54] TASS, "The MTO System of the Russian Army Has Provided Its Reliability in Syria."

[55] Gavrilov, "Bugalkov: Dlya Sirii Mi Sperva Sozdali Bazy, A Zatem Prinyali Voiska."

[56] Reports indicate that Russia used a mix of military landing ships and Sparta-class dry-cargo carriers. Gavrilov, "Bugalkov: Dlya Sirii Mi Sperva Sozdali Bazy, A Zatem Prinyali Voiska"; Bulgakov, "Osonennosti Materialno-Tehnicheskovo Obespecheniya Rossiiskoli Gruppirovki Voisk (Sil) V Siriiskai Arabskoi Respublike."

[57] Nersisyan, "Rosiiskiye Vertoletnosci: Bit Ili Ne Bit?"

[58] TASS, "The MTO System of the Russian Army Has Provided Its Reliability in Syria."

[59] Ultimateblog777, "TTTO Osnovnie Ponatiya U Opredeleniya Tankomehanicheskovo Obespecheniya Onlain."

[60] Serba and Grachev, "Problems and Directions of Improving the System of Material and Technical Support of the Armed Forces of the Russian Federation."

[61] Serba and Grachev, "Problems and Directions of Improving the System of Material and Technical Support of the Armed Forces of the Russian Federation."

[62] Naumov, "Opit Organizacii Upravleniya Tilom Rossiiskovo Kontingenta V Zonah Gruziino-Osetinskovo I Gruzino-Abhaznovo Konfliktov."

[63] Adamsky, "Continuity in Russian Strategic Culture: A Case Study of Moscow's Syria Campaign."

[64] Kofman and Lee, "Not Built for Purpose: The Russian Military's Ill-Fated Force Design."

[65] Naumov, "Opit Organizacii Upravleniya Tilom Rossiiskovo Kontingenta V Zonah Gruziino-Osetinskovo I Gruzino-Abhaznovo Konfliktov."

[66] Bowen, *Russia's War in Ukraine: Military and Intelligence Aspects*. See also Kofman and Evans, "Into the Third Week: Will Russian Forces Need to Pause?"

[67] Bobych.ru, "Lekcii Po Organizatsii I Venediyu Tilovovo Obespecheniya."

[68] Akimov and Zhernakov, "Deystvuya Na Operatsiya. Razvitiye Tekhnicheskoy Obespechennosti Sistemy Material'no-Tekhnicheskogo Obespecheniya – Zalog Boyesposobnosti Vooruzhennykh Sil Rossiyskoy Federatsii."

[69] Watling and Reynolds, "Operation Z. The Death Throes Of An Imperial Delusion."

[70] Boston and Massicot, *The Russian Way of Warfare: A Primer*.

[71] "Belarus Eyes Wider Death Penalty Use After Anti-War Railway Sabotage."

[72] Engquist, "A Railhead Too Far: The Strategic Role of Railroads During Russia's Invasion of Ukraine."

[73] Bendett, "Russia's Military Is Writing an Armed-Robot Playbook"; Ministry of Defence of the Russian Federation, "Avtotehnicheskoye Obespecheniye Voisk I Voinskiye Avtomobilniye Perevozki. Chast 2. Voinskiye Avtomobilniye Perevozki."

[74] Roblin, "Ukraine Says It Captured Documents Revealing That an Elite Russian Unit Lost over 130 Tanks in Failed Attacks on Kharkiv."

[75] Ministry of Defense of the Russian Federation Main Department of Combat Training of the Armed Forces of the Russian Federation, "Uchebnik Serzhanta Motostrelkovih Voisk."

[76] Russian officials have reported increased numbers of defects and insufficient corrosion resistance in the existing pipelines since around 2009. The third-generation fiberglass pipelines are reported to supply fuel as far as 40 km. TASS, "Rossiiskaya Armiya K 2020 Gody Mozhet Poluchit Sborno-Razbornii Trubovod Novovo Pokoleniya"; Grau and Bartles, "Getting to Know the Russian Battalion Tactical Group."

[77] Bullen, "Ukrainian Fighters Destroy Russian Fuel Tanker and Armored Vehicles."

[78] In addition, although Russian authors write about the need to destroy the enemy's aircraft in the air and on the ground, during the initial period of hostilities and block of aircraft at airfields, Russia failed to devote a substantial effort toward accomplishing this goal, at least to some extent because of the United States sharing intelligence with Ukraine, which was then able to move its air assets away from the air strike areas. Rushton, "HIMARS is back in action: another Russian ammo dump just exploded incredibly dramatically"; Dilanian et al., "U.S. Intel Helped Ukraine Protect Air Defenses, Shoot Down Russian Plane Carrying Hundreds of Troops"; Bytkovsky, "Problemi Tehnicheskoi Osnashennosti Podrazdelenii Inzhenerno-Aerodromnovo Obespecheniya V Sostave Mobilnih Komendatur."

[79] Missilery, "Unguided Rocket Projectile 9M27F."

[80] Popov, "Uroki Donbassa. Tekhnicheskiye Sredstva Veshchevoy Sluzhby Stanovyatsya Boleye Funktsional'nymi I Mobil'nymi."

[81] Trishunkin et al., "Analiz Usloviy I Faktorov, Opredelyayushchikh Kharakter Dal'neyshego Sovershenstvovaniya Sistemy Mto, Ikh Vliyaniye Na Razvitiye Sposobov Resheniya Voznikayushchikh Zadach Dlya Obespecheniya: Gruppy Voysk (Sil) V Sovremennykh Operatsiyakh Chast I."

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About This Report

The failures in the Russian logistics and maintenance system have been identified in several open-source reports as a key factor in Russia's underperformance in Ukraine in 2022. Despite the renewed interest in the topic, Russia's military logistics and sustainment remain an under-researched area of study in the West. The purpose of this report is to reduce the knowledge gap on Russian logistics and sustainment by presenting a short overview of Russia's material logistics and sustainment system and its problems as identified by Russian authors prior to February 2022. The report also presents some preliminary insights into the early stages of the Russia-Ukraine War of 2022. The analysis included in this report was finalized in January 2023.

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