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The State of Defense Innovation in Russia: Prospects for Revival?

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Since 2005, the Russian defense industry has experienced a sharp rise in domestic demand for its goods and services. Since 2008, the rise of defense procurement has significantly affected the production volumes of conventional arms producers. Prior to this period, most of the resources were dedicated to strategic weapons. Early in 2011, the Russian government approved a huge state armaments program, which is worth 20 trillion rubles (US$570 billion at January 2014 exchange rate), and is supplemented by a separate program for development and modernizing the defense industry, which is worth 3 trillion rubles (US$85 billion). The industry, which has survived for some 15 years solely on exports, is now working mostly for the Russian armed forces. With the rise of domestic demand, the old institutional problems of the Russian defense procurement and research and development (R&D) planning again came to light. These problems have directly affected the Russian defense industry's capacity and willingness to innovate.

With the military leadership deeply dissatisfied with the performance of defense industry companies and bashing the industry in the media, industry leaders have responded by pointing at the numerous shortcomings at the Ministry of Defense (MoD) decision-making process, especially on the ministry's inability to formulate reasonable requirements for new types of equipment. These struggle has ultimately resulted in a change of MoD leadership and another round of reforms started in 2012 that affect the military equipment pricing system and the whole defense-related R&D system. A new body, the Advanced Research Foundation, was created to coordinate defense-related research. The military is "MoDifying" its weapons procurement planning system. If successful, these reforms can create favorable institutional conditions for a revival of defense industry innovation in Russia.

A number of macroeconomic and internal policy factors can significantly affect the process of that revival. The Russian defense budget since 2000 has risen from 2.63 percent of GDP to 3.2 percent of GDP in 2013. Currently it stands at 2.14 trillion rubles (US$65 billion) and further increases are expected. Russian leaders do consider defense modernization one of their budget priorities, allocating more that 16 percent of total government spending to the military. But in an economic crisis they will cut defense spending to maintain the high level of spending on social security nets. With its close dependence on ties with the European Union (more than 50 percent of trade volume), the Russian economy is starting to stagnate: GDP growth in the first half of 2013 was just 1.6 percent. With both the

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global and internal economic situations so unpredictable, we cannot exclude the possibility of significant Russian defense spending cuts in the coming years.

The outcome of large-scale reforms being conducted by the Russian government in the areas of higher education and civilian science is another important factor that will affect the defense industry innovation capacity in the longer term. The reforms, especially the reform of the Russian Academy of Sciences (RAS), are meeting very strong political resistance and the fight is far from over. If the government succeeds with its plans a rise in scientific productivity of the major universities and RAS research institutes can be expected. In this case, the defense industry will be able to benefit from cooperation with the civilian R&D sector and recruit better engineers and researchers from the civilian economy. The failure of the reforms will further complicate the position of the defense industry which, together with the closely integrated nuclear and space industries, is the only significant and successful high-tech sector of the current Russian economy.

Russia's Post-Soviet Defense Procurement and R&D Planning

The process of procurement and defense-related R&D conducted in the interests of the Russian military is regulated by 10-year State Armaments Programs (SAP). According to the usual practice which dates back to the Soviet period, each SAP consists of two five-year periods. The planning for the second five-year period is preliminary and is always revised. For that purpose, a new SAP is adopted every five years.

The first stage of SAP development is preparation of a so-called unified system of benchmark data (USBD) (Единая система исходных данных, ЕСИД), a huge array of data on the types, technical characteristics and quantity of equipment which will be needed by all of the Russian armed forces within the forecast period.[1]

At the same time, the MoD is developing another document, the "Main Directions in the Development of the Armaments, Military, and Special Equipment (Основные направления развития вооружения, военной и специальной техники)." Main Directions are the key document for defining the priorities for R&D work within the SAP framework. The Main Directions are based on analysis of trends in military technology development in Russia and abroad and on requirements of the armed forces.

USBD and the Main Directions provide the basis for development of the SAP, which takes into account the military and political situations, the innovation potential and production capacity of the defense industry, and requirements of the various branches of service. SAP can consist of separate procurement and development programs for single types of weapons or of "complex programs" (Коплексные целевые программы), which regulate the process of development and procurement of whole families of equipment and weapon systems.

Historically, the Russian MoD has had a special unit responsible for tracking trends in science and technology and mapping the priorities in military innovation. In the Soviet period, the 13th Directorate of the MoD was responsible for that work. The current ministry department is the Chief Directorate for Scientific and Research Work and for Technological Support of Advanced Technologies (innovative research). The department is supposed to formulate the position of the ministry towards advanced research, organize research projects and, most importantly, control the application of advanced technologies in the military and in the defense industry.

The SAP for 1991–2000, which was approved in the last days of the Soviet Union, was abandoned soon after the USSR collapsed, and until 1995 no long-term procurement program took its place. In 1995 the government made its first attempt to return to the practice of long-term programs, but the SAP 1995–2005 was abandoned in 1997 as Russian macroeconomic indicators continued to deteriorate. Almost the entire MoD budget for procurement was dedicated to the nuclear forces (in 1999–2000, strategic forces accounted for 95 percent of the procurement).

1 V. M. Burenok, "Russian Federation Armaments Systems Programs and Targeting Planning Evolution and Perspective," *Vooruzhenie I Ekonomika* 4 (2012): 22. In Russian.

The SAP 2001–2010 was also unsuccessful. Its volume was just 2.1 trillion rubles on paper. In reality, just some 50 percent of that amount was allocated to the defense procurement budget; the rest was concentrated on the procurement of nuclear weapon systems. Most of the resources allocated to conventional weapons were spent on R&D, with continuing use of the Soviet heritage systems.

However, during that same SAP period Russia started to increase its procurement budget. In 2005, the military procurement budget increased by more than 30 percent and reached 148 billion rubles (US$6.6 billion). This was the first year of the post-Soviet period when state defense procurement was larger than arms export (in 2005, export was $6.1 billion). However, most of the resources still were channeled to the strategic systems such as ICBMs, SLBMs, and ballistic missile nuclear submarines.

In 2006 the SAP 2007–2015 was adopted, the first SAP of post-Soviet Russia that the government managed to implement to any significant extent. The SAP 2007–2015 total volume was 4.91 trillion rubles, of which 4.51 trillion (91 percent) was dedicated to MoD needs. The rest went to the Federal Border Protection Service, Ministry of Interior, and other uniformed agencies. R&D accounted for 20 percent of SAP volume, procurement of the new weapon systems and equipment for 63 percent, and the rest was dedicated to upgrades of existing systems.

The share of the nuclear forces in the procurement budget had fallen sharply, standing at just 23 percent in 2007.[2] However, the war against Georgia that began in August 2008, although successful, led to a deep reassessment of the defense priorities. In 2009 MoD declared that special attention would be paid to the following areas:

- strategic nuclear forces;
- aerospace defense systems;
- C4ISR systems and precision strike weapons; and
- improvement of military infrastructure.

The first five-years term of SAP 2007–2015 was fulfilled by 95 percent in financial terms, according to the official figures.[3] However, the military often expressed dissatisfaction with the quality and pricing of the weapons systems. In some areas, such as UAV development, the situation was considered to be completely unsatisfactory and the MoD and other agencies turned to limited-scale imports.

In 2011 a massive new SAP (2012–2020) was adopted after lengthy discussions involving the Ministries of Defense, Finance, and Economics, the president and the prime minister. The discussions were so heated that the final adoption of that SAP, worth some 20.7 trillion rubles (19 trillion to the MoD, 1.7 trillion to other state agencies for procurement) plus 3 trillion dedicated to industry modernization, caused Alexey Kudrin, the Russian vice prime minister and minister of finance and one of the most important political figures in the Russian government of at the time, to resign. Kudrin proposed a much more limited package of 14 trillion rubles, but that amount was considered to be insufficient for the military modernization.

The new SAP is supposed to replace the majority of the Soviet heritage systems with new types of weapons (it was declared that the share of "MoDern" systems will increase to some 70 percent of the MoD inventory). SAP resources will be concentrated on procurement of new systems produced by the Russian industry (70 percent). The budget shares dedicated to upgrading existing equipment and R&D are more limited, with R&D accounting for 16–20 percent of the SAP value. Large portions of R&D work on the advanced projects are supposed to be done during the previous periods and now the MoD leadership wants to concentrate on rearmament.

2 "The Reform of the Army and of the State Defense Order," Army Messenger, December 19, 2010, http://army-news.ru/2010/12/gosoboronzakaz-rossii-chast-1/.

3 V. M. Burenok, "Russian Federation Armaments Systems Programs," 14.

For example, the MoD is supposed to receive some 600 fixed-wing aircraft, including 60 T-50 fifth-generation fighters; up to 96 Su-35S fighters; up to 60 Su-30MKM fighters; and 129 Su-34 bombers. It will also receive some 1,100 helicopters, including 167 Mi-28N and around 180 Ka-52 attack choppers. The ground force expects to receive approximately 2,300 heavy tracked combat vehicles and 2,000 new artillery systems. The Russian Navy will be getting new ballistic missile submarines, new nuclear and conventional multipurpose submarines, and new-generation frigates and destroyers. A new aircraft carrier project is being discussed, and the Navy will receive two *Mistral*-class LPDs from France.

Russian Rearmament and the Demand for Defense Industry Innovation

One important characteristic of the SAP 2020 is that it calls for radical innovations in most areas of military technology. During the current decade, the Russian armed forces are supposed to start receiving weapons systems based on completely new designs, not just upgrades of older systems.

For example, after receiving a large number of upgraded fourth-generation combat aircraft based on Su-27 and MiG-29 platforms (Su-30MKM, Su-34, Su-35, MiG-29K, MiG-35) closer to the end of the decade, the Air Force and the Navy's air arm are supposed to start getting the T-50 fifth-generation fighters. The Army plans to start procuring three completely new families of armored vehicles, such as the Armata tank (heavy tracked vehicles), Kurganets-25 (medium tracked vehicles) and Boomerang (medium wheeled vehicles). Air Force and Army air defense units will receive upgraded S-300PMU, S-300V and Buk family systems, but also a number of the new S-400 (56 systems), S-500 (10 systems), and S-350 (38 systems) systems, as well as 120 Pantsir-S gun-missile systems. The Navy will receive a new type of conventional submarine (Project 677 Lada) as well as 10 Project 955 ballistic missile submarines and 10 Project 885/885M nuclear submarines.

In fact, throughout the first two decades of the twenty-first century, the Russian defense industry has been carrying out a large number of very ambitious and technologically risky development programs. Some of these most important programs have already reached the stage of serial production. Their fate can tell us something about the overall prospects of the Russian defense modernization drive.

One such example was the R-30/RSM-56 Bulava (NATO designation SS-NX-32) submarine launch ballistic missile (SLBM) project, started after the failure of the previous solid fuel project called Bark. Unlike Bark, which built on the earlier D-19 system, Bulava was a completely new missile, the first Russian lightweight solid fuel SLBM with intercontinental range. The number of improvements compared to the previous generations of Russian SLBM was huge: the Bulava was planned to be more than 50 percent lighter than Bark, easier to maintain, have improved flight controls, an improved countermeasures suite, and some subsystems taken from the ground-based Topol-M intercontinental ballistic missiles (ICBM).

The Bulava project started in 1998 and quickly turned into a serious financial burden and public relations disaster for the Russian military. Increasing problems within the Russian industrial base coupled with the large number of radical innovations in this missile led to a chain of flight test failures. Billions of dollars were spent on it in the late 1990s-early 2000s even while the Russian strategic missile troops were getting just a minimum of new equipment and the army was fighting a bloody war on the Northern Caucasus with the old Soviet weapons. Even three to four years ago, most commentators expressed the view that Russia had to abandon the project and to continue gradual upgrades of the older missile types such as the liquid fuel R-29RM Sineva.

However, by early 2013 the first missiles were commissioned aboard the *Yuri Dolgorukiy* Project 995 submarine. At the end of the day, the Russian Navy got its first truly modern SLBM, comparable to current Western designs, which will provide a solid technological basis for the development of the Russian Navy's nuclear forces for decades to come.

Although the system continues to experience difficulties and can be expected to face them for some time (another launch in September 2013 failed because of production flaws, according to a preliminary investigation), the Bulava managed to complete trials, went into serial production, and is being deployed. That can be considered a model for many other major Russian defense innovation programs: Ambitious goals lead to huge cost overruns and significant delays. However, the industry is usually able to bring these projects to acceptable results.

There are similar stories of weapons systems development that would be considered quite ambitious, even by Soviet standards. Although many setbacks were suffered and the original schedules were not followed, the Russian military has managed to get the systems it needed, such as the Pantsir-S air defense gun/missile system, S-400 and S-300VM4 SAM, and the Iskander (SS-26 Stone) theater ballistic missile. According to the available data, work on the fifth-generation fighter is progressing more or less according to the plans and the second stage engine for the aircraft will likely start flight testing by mid-2015. Even larger projects are underway, including a heavy ICBM, a long-range bomber, strategic missile defense systems, and laser weapons. If the government fulfills its financial commitments, we can expect most of the projects to succeed, although the timetable provided in the SAP 2020 seems too optimistic if we consider the amount of technological risk.

However, there are a number of clear problem areas where the prospects for defense innovation are less certain, mostly in the areas that started to figure prominently in military modernization in the 1990s. Russia did not have established design and production capabilities in these areas when the Soviet Union collapsed and could not establish such capabilities during the 1990s–early 2000s. As result, Russia is clearly falling behind not just the West, but also China and other developing countries. The most notable example is the area of unmanned aerial vehicles (UAV). SAP 2020 includes provisions for creating a full range of UAVs including lightweight company and platoon-level vehicles, MALE-class UAVs and, later, attack UAVs with a takeoff weight of up to 20 tons. However, most projects are at relatively early stages compared to the same kind of projects in China. Since 2009 Russia has received limited imports of UAVs from Western suppliers such as Israel (IAI Searcher Mk. 2) and Austria (Camcopter S-100, license production in Russia started). Access to the Western equipment is supposed to provide the military and border troops commanders with valuable tactical experience and will allow them to better prepare their requirements for the new Russian UAVs. The government is gradually increasing investment in the development of new UAV types. For example, the company Russian Helicopters, headquartered in Moscow, alone is running three rotary-wing UAV projects with a total budget of 5 billion rubles (US$160 million).

Even more problems are related to net-centric warfare technologies and the new personal combat gear and equipment sets. In these areas the difficulties are caused not just by the shortcomings of the Russian production and R&D base, but also by an apparent inability of the military to come up with a well-developed set of requirements for such equipment. As with the UAV, the MoD pays a lot of attention to studying foreign examples. For example, a number of the French FELIN individual infantryman equipment sets were bought and tested, greatly influencing the work on the Russian Ratnik. Other examples of where Russia is trying to compensate for weaknesses by accessing Western technology and using foreign equipment as a benchmark for local producers include certain kinds of infantry weapons, such as heavy sniper rifles, and certain types of logistics equipment (in 2012 the MoD declared plans to buy a large number of the advanced Volvo 12-10FMX40 tanker trucks).

Government Policies to Boost Defense Industry Innovation Capabilities

Despite its very ambitious approach to defense modernization, the Russian government often voices dissatisfaction and concern with the innovation capabilities of the defense industry. Deputy Minister of Industry and Trade Igor Karavaev has noted that current defense technology development in Russia is largely based on breakthroughs made

in the 1970s and 1980s, and soon these reserves for innovations may be depleted.[4] He has further noted that the government should actively support defense industry innovative development by providing companies with subsidies, tax cuts, loans, financial support for labor force training as well as a number of other measures.[5] In many cases, rather grim statistics are being published about innovation processes in the Russian defense industry. For example, in 2009 the share of "innovative products" in the Russian defense industry stood at just 13.9 percent and held stable for some years.[6]

However, to interpret these numbers correctly, we should be aware of what kind of products are considered innovative by Russian standards. This is regulated by a special instruction published by the Russian Federal Service of State Statistics in 2008, according to which a product is considered innovative only if it was designed or underwent a major upgrade within the last three years.[7] It is easy to see that such an approach can hardly be used for most types of defense equipment, which typically has very long development and production cycles.

The government is continuing a large-scale restructuring of the defense industry that is supposed to lead to concentration of almost all of the industry assets in 40 integrated specialized corporations, or "research and production companies." These companies are supposed to both satisfy the Russian military's need for modern equipment and increase their presence in civilian markets. Currently such integrated companies already provide more than 60 percent of the industry production volume. The government intends to encourage the defense industry companies to diversify their businesses. As of 2011, the Russian defense industry received 22 percent of its combined revenue from defense-related exports, 45 percent from military equipment sales in the domestic market, and 33 percent from civilian products and services. In the longer term, the government wants to increase the share of civilian products to around 50 percent of the revenue, according to Dmitry Rogozin, the Russian vice prime minister in charge of the defense industry.

There are modest improvements in the structure of the defense industry workforce. As of 2011, the share of workers under 35 years of age was 27 percent (in 2009, it was 20 percent). The average age of the industry workers as of 2011 was 46 years. At 25.5 thousand rubles per month (US$868), the average salary in the industry stood well above the national average of 21.3 thousand rubles at that time. To attract additional personnel to the key research and production facilities the government provides certain defense industry employees with monthly stipends of around 20 thousand rubles. From 2004 to 1020, the stipends were granted to key research and development staff for successful work in the defense sector; since 2010 the scheme has been expanded to younger (under the age of 35) specialists who displayed successful work.[8]

The Russian government is trying to boost industry innovation capabilities by implementing a number of federal programs. In total there are nine programs supporting industry development. The biggest among them is the Defense Industry Development Program 2020 with a total budget of 3 trillion rubles (around US$90.9 billion), which is supposed to boost investment. The program itself is nothing but a continuation of the Defense Industry Development Program 2015. Defense Industry Development Programs follow the same logic as SAPs and are supposed to be reviewed every five years. The first period of the Program 2015 is considered by the government to be a success. It is said that during 2007–2011 the program contributed to the construction of 180 new production and research facilities and enabled the industry to produce around 70 percent of arms and equipment planned for that period.

4 I. Karavaev, "Some Aspects of Innovative Activities in the Russian Defense Industry," Economic and Social Developments: Facts, Trends, Forecasts," 2/2012, http://esc.vscc.ac.ru/file.php?MoDule=Articles&action=view&file=article&aid=2024. In Russian.

5 I. Karavaev, "Main measures of the state support of the Defense Industry," Economic Relations, 1/2012 http://www.creativeconomy.ru/articles/24608/. In Russian.

6 S. Kudriavtseva, "Innovation Processes in the Defense Industry," http://innclub.info/. In Russian.

7 "Innovative Business," *Moscow Accountant Journal*, August 30, 2011, http://www.buhgalteria.ru/article/n50189. In Russian.

8 S. Dovgutchits, "On the Developments of the Situation in the Defense Industry in 2011," http://federalbook.ru/files/OPK/Soderjanie/OPK-8/III/Dovguchic.pdf. In Russian.

The other eight defense-related federal programs are:

1. Development of the Nuclear Arms Industry;
2. Federal Space Program;
3. Development of Civilian Aerospace Technology;
4. Development of the Pharmaceutical Industry and Medical Equipment Industry;
5. Strategic Materials;
6. Electronic Components and Microelectronics Production Base Development;
7. National Technological Base: Machine Tools and Diesel Engine Production Development; and
8. GLONASS (Global Navigation Satellite System).

Some of the programs are formally aimed at import substitution in the civilian markets, but since they are to be implemented by defense industry corporations, they will significantly affect industry's productivity and innovation capabilities.

It is obvious that the Russian defense industry is experiencing a revival of R&D activities that has already led to the introduction of a number of highly innovative systems. This revival is largely based on the use of the highly-trained Soviet personnel, vast Soviet experience in implementation of risky high-tech projects, and huge government investments. At the same time, a number of unresolved problems persist, mostly attributable to the nearly permanent crisis in the Russian fundamental science and higher education systems since the collapse of the Soviet Union. For example, the Russian share of scientific publication in the major international scientific journals was just 1.5 percent in 2010 in the SCIMago journal and country rankings and has continued to fall. RAS, the largest Russian scientific establishment, is in a permanent state of organizational chaos, and the latest round of the government attempts to reform it has not produced any decisive results.

Even the best Russian universities hold only modest positions in the leading international ratings. Usually only two of them, Moscow State University and Saint Petersburgh State University, appear in such lists. While the government tries to boost a number of leading research universities' R&D capabilities (with some good initial results), the system of research institutes within the RAS is so poorly managed that any meaningful cooperation between them and the defense industry becomes difficult. In response, the government decided to create a specialized agency in charge of advanced research for the needs of the national defense. The agency is supposed to identify priority areas, dispense funds among the research institutes, and tightly control project implementation.

Creation of the Advanced Research Foundation (ARF)

The idea to create a special agency for financing advanced research programs, modeled after the U.S. Defense Advanced Research Projects Agency (DARPA), was voiced for the first time by President Dmitryi Medvedev in September 2010. However, practical work on the project did not start until a year later, in September 2011, when Medvedev ordered Vice Prime Minister Dmitriy Rogozin to prepare the relevant bill for the parliament. It was passed by the State Duma and signed into law by President Vladimir Putin on October 16, 2012 (law N174-FZ "On Advanced Research Foundation").

According to this law, ARF is supposed to "encourage the implementation of the high risk breakthrough research in the interests of the State defense and security." The foundation can conduct economic activities only in the areas which are designated by the relevant law and should use all of the received profit for the support of the advanced research. Other state agencies have no right to intervene into foundation activities and cannot influence the ARF decisions on which research should be supported.

The experts working for ARF are supposed to identify critical threats to the national security in the technological arena and choose the ways to neutralize such threats. After that, ARF management is supposed to identify the companies and research institutions that will conduct the relevant research. The intellectual property rights for the research results will belong to ARF. ARF can transfer these property rights to defense industry companies, which are supposed to apply the results of the research.

ARF is supposed to prepare three-year research programs, which are subject to yearly reviews. Projects to be included into the programs are supposed to be chosen by the ARF Council on Science and Technology and then should be confirmed by the ARF board, which consists of the ARF director general and his deputies in charge of various research areas. Another important organ within ARF is its 15-member board of trustees. Seven of the members are appointed by the Russian president and seven by the prime minister; the final member is the ARF director general. Currently the board consists of the top managers of the key Russian defense industry corporations such as Rostech, United Aircraft Corporation, and Rosatom as well as top officials from the MoD, Federal Security Service, Ministry of Energy and Trade, Ministry of Science and Education, and the Russian Space Agency.

The first director general of ARF, Andrei Grigoriev, was appointed in January 2013. Grigoriev formerly worked in the Federal Service of Technical and Export Control, a highly secretive organization responsible for the technological aspects of state security, including work on the relevant regulations for the defense industry and for the military. ARF is supposed to have just 100 employees to oversee up to 150 projects simultaneously. At this time they have only eight major projects. From the limited amount of information available, we know that one of the projects is supposed to develop the technologies necessary for the futuristic personal combat gear and equipment that will eventually replace Ratnik, which is expected to start equipping troops soon. Other projects are reportedly related to the areas of chemical biology, medicine, physics, and information technology.

In an August 2013 interview, Grigoriev confirmed that, in fact, the only thing in common between his foundation and DARPA is that both organizations are in charge of very-long-term R&D projects which sometimes can bring results only after 15 to 20 years. At the same time, he noted that DARPA exists in a different ecosystem, where it sometimes can choose just the most promising of many projects conducted in the U.S. universities and other research centers that may already enjoy significant financial support via different channels. ARF will have to finance its projects from beginning to end. Grigoriev reiterated that ARF is in no way intended to duplicate the functions of the Innovation Department in the MoD. ARF projects will tend to take a longer perspective than the MoD-financed projects and will be administered differently. Grigoriev also underscored that his foundation will extensively use external expertise for project assessment.[9]

Conclusion

Generally speaking, the process of defense innovation revival is already happening in the Russian defense industry. The situation in the industry has stabilized and the most acute problems with manpower and equipment are being resolved, with some degree of success. The biggest challenges for the industry are filling the gaps in the sectors that were underdeveloped or non-existent in the Soviet defense industry or were lost during the 1990s. In the long term, the future of the Russian defense industry's innovative capabilities will depend on the ability of the Russian government to conduct an effective reform of the Russian Academy of Sciences and of the Russian higher education system.

9 "'We are ready to work with any company.' Interview with Andrei Grigoriev, Director General of the ARF," *Eksport Vooruzheniy* 105 (August 2013).