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Russian Combat Aviation: Procurement, Modernization, and Future Outlook

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Abstract

In this CNA Occasional Paper, Leonid Nersisyan analyzes developments in Russia's combat aviation fleet from 2006 to 2019. The report provides an in-depth assessment of Russia's tactical, strategic, and army aviation forces, detailing key combat aircraft and munitions procured by the Russian Air Force and Navy. Additionally, Nersisyan discusses the ongoing modernization program, prospective fixed-wing and helicopter acquisitions, and related challenges that the fleet may face in the coming years.

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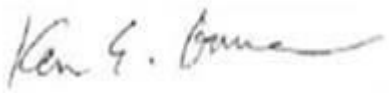

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Executive Summary

This paper provides an overview of Russian combat aviation modernization and procurement efforts from the period 2006 to 2019, and discusses how the recent endeavors follow from Russian Air Force and naval aviation capability reductions in the 1990s and early 2000s. It divides this topic into three main parts, focusing in turn on Russian tactical, strategic, and army aviation. Within each section, the paper examines the key combat aircraft and attack helicopters that the Russian military developed or procured from 2006 to 2019. It also considers the future development and potential acquisitions in each category. This paper endeavors only to cover combat aviation and does not include an assessment of other resources, like trainer aircraft, multipurpose helicopters, or specialized assets.

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Introduction

Combat aviation is one of the most important parts of the armed forces. It provides quick power projection, and enables successful action in local conflicts with minimal casualties. In the 1990s, the obsolescence of Russian combat aviation, combined with the lack of modern precision-guided munition, led to a serious reduction in the operational capability of the Russian armed forces and to the inability to operate with high efficiency even in local conflicts. In order to understand the current capabilities of the Russian armed forces, it is important to review the modernization of the Russian Air Force that began in the mid 2000s, its achievements, and its future prospects.

This paper focuses on the modernization of Russian combat aviation and the procurement of new aircraft for it in the period from 2006 to 2019. In addition, it covers further development and prospective acquisitions of combat aircraft and helicopters in the coming years.

The report begins with a short historical overview of the state of Russian Air Force and Navy combat aviation in the 1990s and the beginning of 2000s, followed by a detailed description of the developments that have taken place in recent years. The main body of the report is divided into three parts, one each devoted to Russian tactical, strategic, and army aviation. Each of these three parts has separate subdivisions on the key combat aircraft and attack helicopters that entered the armed forces or were undergoing upgrades between 2006 and 2019. The issue of aviation munitions used by Russian combat aviation is also covered. The conclusion provides summarizes data on the deliveries of new combat aircraft and helicopters, and assesses the changes, problems, and current capabilities of the Russian aviation.

Note that the analysis covers only combat aviation—i.e., various fighters, fighter-bombers, attack aircraft, bombers, and attack helicopters. It does not include resources such as trainer aircraft or multipurpose helicopters, or specialized assets such as antisubmarine or reconnaissance aircraft.

Background

The collapse of the USSR and the long-term economic crisis of the 1990s were extremely damaging to the Russian Air Force and Naval Aviation. For many years, the major purchases of new combat aircraft for the armed forces stopped. Despite the fact that in the 1990s mainly the newest and modern aircraft were left in service, significant funds were needed to maintain them in an operational status and for upgrades. This funding was not allocated, resulting in a reduction in the number of operational aircraft. Though the situation was gradually improving in the 2000s, the funds provided by the government were not enough to start massive modernization of the Russian combat aircraft fleet, since the procurement of aircraft is very expensive.

The first major contracts for the purchase of new combat aircraft and helicopters were concluded in the second half of the 2000s. At the same time, the gradual intensification of contradictions with the West and the Russo-Georgian War in 2008 accelerated the plans for modernization of the Russian armed forces in general and combat aviation in particular.

By the beginning of the 2010s, the vast majority of combat aircraft of the Russian Air Force and Naval Aviation had been produced in the Soviet Union and only a few of them had been significantly modernized. The new state armament program to 2020 was approved in 2010, and 24 percent of it was supposed to be allocated to the Russian Air Force.[1] Although there were problems during the implementation of this program, Russian combat aviation has been significantly upgraded over the last decade. Finally, given the dramatic changes in circumstances, in 2018 the program was replaced by the state armament program to 2027. Some goals not achieved by the previous program, such as mass production of the Su-57 fifth-generation fighters, were incorporated into the new state armament program.[2]

[1] "Gosudarstvennye programmy vooruzheniya Rossii. Dos'e," TASS, 26 Feb. 2018, https://tass.ru/info/4987920.

[2] Konstantin Bogdanov, "Podpisalis' na 10 let," Izvestia, 28 Feb. 2018, https://iz.ru/714058/konstantin-bogdanov/podpisalis-na-10-let.

Tactical Aviation

Now, while expecting the introduction of the Su-57 fighters, the backbone of the Russian combat tactical aviation is represented by MiG-31 interceptors and Su-27 family fighters such as the Su-27 themselves, as well as Su-30, Su-33, Su-35S, and Su-34 fighter-bombers. The proportion of the MiG-29 fighters has significantly decreased, and even the beginning of production of new MiG-35 fighters is unlikely to change this situation greatly. Against the background of an increasing number of Su-34s, Su-24 frontline bombers are gradually retiring from service, but the modernization of Su-25 attack aircraft is continuing and they are likely to be in service until the end of the life cycle.

As a result, there has been a significant change in Russian tactical combat aviation in general. Most importantly, its core now consists of modern heavy multifunctional fighters and fighter-bombers capable of using various guided aircraft munitions, both air-to-air and air-to-ground. Correspondingly, the range of guided aircraft munitions that are entering into service is also widening.

MiG-29 fighter family

MiG-29 is a family of twin-engine multirole fighters. According to the Soviet and Russian classification it belongs to the light fighters, despite the fact that in terms of mass and weight it is equal to or even larger than such Western fighters as Dassault Rafale, Eurofighter Typhoon, or McDonnell Douglas F/A-18C/D Hornet.

The fighter was designed in the early 1970s as part of the LPFI (*Perspektivnyy Lyogkiy Frontovoy Istrebitel*, or "Advanced Lightweight Tactical Fighter") program, paired with a heavy fighter, which later turned into the Su-27. The main objective for MiG-29 was to counter the most advanced American F-15 and F-16 fighters, while close air support was a secondary objective. The first mass-produced MiG-29s were first supplied to the Soviet Air Force in 1983. By the end of 1991 almost 1,400 fighters of all modifications had been produced, including export deliveries, of which about 400 were transferred to the Russian Air Force.[3] At some point since 1992, it was decided not to procure the MiG-29, in order to focus extremely limited financial resources on the development of the more promising Su-27 family.

[3] "MiG-29S," *Ugolok neba* aviation encyclopedia, http://www.airwar.ru/enc/fighter/mig29s.html.

The major part of the MiG-29 fighter fleet soon became nonoperational or was not in service, because of the reduction in the size of the Russian Air Force. In addition, the Soviet-made MiG-29 fighters were found to have a short lifespan, which was further impaired by poor facilities (most Russian air bases have too few hangars for planes, and vehicles are standing in the open air). The conditions were especially difficult on the vertical tail fins, which turned out to be highly affected by corrosion.[4]

For this reason, it was decided not to upgrade the earlier produced MiG-29, unlike such aircraft as the MiG-31, Su-24, Su-25, and Su-27. A limited overhaul and repair effort started in the late 2000s in order to extend the life cycle of the MiG-29 fighters in those few units that were not replaced by other types of aircraft. For instance, it is estimated that only seven vehicles were repaired between 2008 and 2010.[5] This activity has subsequently ended. For 2013, only about 20 to 25 percent of the MiG-29s were operational.[6] Thus, it appears that in 2020 there are almost no MiG-29 fighters of original Soviet modifications in the Russian Air Force (with rare exceptions, such as those at the 102nd Russian base in Armenia).

Almost all the aircraft of this family that are currently in service were produced in Russia. The first of them were 28 single-seat MiG-29SMTs (internal developers' designation 9-17) and six MiG-29UBs (9-53), originally manufactured for Algeria but procured by Russia in 2009-2010 as a result of contract termination.[7]

In 2006, Algeria signed a contract for the purchase of 28 new single-seat MiG-29SMT fighters and six twin-seat MiG-29UB fighter trainer aircraft at a cost of approximately $1.3 billion. However, a scandal broke out after the delivery of the first 15 aircraft when Algeria declared that pre-owned components were used for their production. As a result of the complete termination of the contract, Algeria not only refused to accept the remaining MiG-29s but also returned to Russia those fighters that had already been delivered. After the re-equipment and replacement of pre-owned parts, all 28 MiG-29SMTs and six MiG-29UB were handed over to the Russian Air Force. The managers of the three companies that were supplying unsatisfactory components were sentenced to imprisonment in 2012.[8]

[4] "Vosem'desyat procentov rossijskih MiG-29 porazila korroziya hvostovogo opereniya," Lenta.ru, 19 Aug. 2009, https://lenta.ru/news/2009/08/19/corrosion/.

[5] "O remonte MiG-29 VVS Rossii," bmpd blog, 9 July 2012, https://bmpd.livejournal.com/282625.html.

[6] "Sostoyanie aviaparka VVS i zadachi OAK po remontu tekhniki," Kommersant, 28 Oct. 2013, https://www.kommersant.ru/doc/2330180.

[7] "Alzhirskie 'MiGi' prizemlyatsya v Rossii," Kommersant, 2 Oct. 2008, https://www.kommersant.ru/doc/1034355.

[8] "Osuzhdeny postavshchiki nekondicionnyh zapchastej dlya eksportnyh MiG-29," RIA Novosti, 25 May 2012, https://ria.ru/20120529/659685042.html.

The MiG-29SMT is distinguished from the legacy MiG-29 (modifications 9-12, 9-13) by its improved avionics (radar, weapon control system, open architecture, the possibility of operating air-to-surface guided weapons, satellite navigation) and a significant increase in fuel capacity, visible in the "hump" of the fuel tank behind the cockpit. In addition, the MiG-29UB (9-53), unlike the older two-seat versions, is a full-fledged training and combat aircraft, as it has a fully operational radar.

However, the purchase of the Algerian MiG-29SMTs by the Russian Ministry of Defense became a true force majeure. Russian Aircraft Corporation "MiG" (RSK MiG) saw the future of its fighter family in the promotion of a more advanced modification, which was developed for the Indian MMRCA tender. However, the delays in its development (probably caused not only by technical problems but also by a lack of interest from buyers) led the company to need financial support, which resulted in a contract for procurement of sixteen MiG-29SMT (9-19P) fighters for the Russian Air Force in April 2014 (the MiG-29SMT(P) designation is sometimes used to distinguish it from the "Algerians").[9] The contract value is estimated at about $450 million.[10] The aircraft were produced at Production Complex №2 in Moscow with additional equipment and testing at Production Complex №1 in Lukhovitsy. The most noticeable differences from the 9-17 modification were a new jamming station in a small pod under the wing, a slightly modified cockpit, and lack of forming lights. Four aircraft were delivered in 2015, and the remaining 12 in 2016.

In addition to the procurement of single-seat fighters, two MiG-29UB (9-53(P)) fighter trainer aircraft were contracted, presumably in 2015, and delivered to the customer at the end of the same year.[11] The planes were manufactured at the Sokol plant in Nizhny Novgorod. In both cases, it is likely that at least some parts of the aircraft were produced using technological reserve. Note that MiG-29SMT is a trade-off modernization of the original 9-12/13 aircraft (proof of this is that India is modernizing the legacy MiG-29 fighters to MiG-29UPG modification, which is very close to MiG-29SMT).

We will review the MiG-29 fighters of a new stage of development with a significantly modified airframe.

[9] "Minoborony i RSK «MiG» podpisali kontrakt na istrebiteli MiG-29SMT," Kommersant, 14 Apr. 2014, https://www.kommersant.ru/doc/2452739.

[10] 16 billion rubles at the exchange rate of April 2014.

[11] "Novye MiG-29UB(R) i MiG-29SMT(R) dlya VKS Rossii," bmpd blog, 27 Dec. 2015, https://bmpd.livejournal.com/1648742.html.

MiG-29K/KUB and MiG-35

First, it is necessary to clarify the naming, which is quite complicated for the production of RSK MiG. The names "MiG-29K" and "MiG-29M" were also the names of late Soviet developments, which have a very distant relation to the modern aircraft with these designations. The MiG-35 designator has been used many times in marketing publications since the beginning of the century (the most well-known case was participation in the Indian MMRCA competition) and sometimes it is even difficult to understand what configuration is meant. However, considering that this article does not cover export modifications of Russian fighters, the task is considerably simplified.

The history of the modern MiG-29K/KUB and MiG-35, as well as a number of other Russian weapon systems, starts with a successful export contract. In 2004 India signed a contract for the purchase of a decommissioned aircraft carrier, Admiral Gorshkov, in a deeply upgraded design, capable of carrying fighters of conventional take-off and landing. The MiG-29 was chosen as the backbone of the air wing, and the contract for the first batch was signed in the same year. Instead of a simple upgrade of the Soviet MiG-29K 9-31, which was tested at the turn of the 1980s and 1990s in parallel with the Su-33, a completely new 9-41 version (and a two-seat 9-47 MiG-29KUB) was created for India. The unique feature of this aircraft is that a common airframe, including a long cockpit, is used both for single- and twin-seat modifications. The only difference between the single- and twin-seat versions is that the rear seat is not equipped with instruments and instead of the pilot's seat there is a small additional fuel tank. This feature creates certain difficulties in determining the type of fighter from the outside, but also distinguishes it from other MiG-29 family fighters.

The land-based fighters currently being promoted on the global arms market under the MiG-29M/M2 designators (9-61/67, one/two-seater, respectively) are almost copies of carrier-based fighters with minimal differences (lack of some components such as a tailhook and folding wing). The MiG-35 purchased for the Russian Aerospace Forces (VKS) is a development of the MiG-29M/M2 with improved (not fully clear to what extent) avionics.

Now that we have sorted out naming, we can move on to the purchase and production history of these fighters for the Russian Armed Forces.

In the late 2000s, the Russian Navy had an urgent need to update the Admiral Kuznetsov aircraft carrier's air wing. Almost all Su-33s were produced in the first half of the 1990s and became obsolete. Export orders for the carrier-based Sukhoi fighters could not be obtained, so it was decided to limit the ongoing works to repairs and minor upgrades of the existing Su-33s, and to procure the MiG-29K/KUB designed for a foreign customer. The contract for the

purchase of 20 MiG-29Ks and four MiG-29KUBs was signed in 2012 and accomplished in 2015.[12]

As for the MiG-35, after the manufacturing of the first two prototypes in 2016, a contract with the Ministry of Defense was concluded in 2017 to procure the first two pre-production aircraft, which were delivered to the VKS in June 2019. Furthermore, in 2018, a contract was signed for the procurement of six production MiG-35s for the Russian Ministry of Defense by 2023.[13]

Su-27 fighters family

The Su-27 fighter was designed in the 1970s within the Soviet Perspective Frontline Fighter program (PFI) to gain air superiority in response to the development of the F-15 fighter in the USA within the F-X program. The fighter was extremely successful and had a great potential for further upgrades and development of new modifications. Currently, the fighter family, which includes the Su-27 fighters as well as the Su-30 and Su-35 multipurpose fighters, constitutes the major load of the Russian fighter aviation. In addition, there are several Su-33 carrier-based fighters left in the Russian Naval Aviation. Finally, on the basis of the Su-27, the Sukhoi Design Bureau has developed the Su-34 fighter-bomber.

Upgrading the Su-27

The first flight of the T-10-1 prototype was performed in 1977, but later the aircraft was seriously redesigned; thus, the first-production Su-27 fighter made its maiden flight in 1982 and only became operational in the mid 1980s. The Su-27UB, a fighter trainer version of the aircraft, was also soon delivered to the military units. In total, about 600 Su-27/Su-27Ps and about 180 Su-27UBs were built together with the flight prototypes for 1992, which were delivered to the Air Force and Air Defense Forces of the USSR. In addition, in the early 1990s, production of the Su-27SK and Su-27UBK[14] export versions of the aircraft began.

During the collapse of the Soviet Union, some of the Su-27 fighters were acquired by Ukraine, Belarus, and Uzbekistan, or were transferred to Kazakhstan in exchange for the Tu-95MS strategic bombers. Despite that, most fighters of this type remained in Russia.

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[12] "VMF Rossii poluchil 24 istrebitelya MiG-29K/KUB," Zvezda, 20 Jan. 2011, https://tvzvezda.ru/news/forces/content/201601201611-ermo.htm.

[13] "Postavki boevyh samoletov v Vooruzhennye Sily Rossii v 2019 godu," bmpd blog, 16 Jan. 2020, https://bmpd.livejournal.com/3907389.html.

[14] "Suhoj' podvodit itogi goda i prazdnuet 70-letie," Take-off magazine, July 2009 (55), http://www.take-off.ru/pdf/07_2009.pdf.

Due to the tough economic situation in Russia in the 1990s, the upgraded version of the fighter with improved avionics and other improvements never entered into mass production. That aircraft was named "Su-27M" and was designed to become a full-fledged multirole fighter capable of using both air-to-air and unguided weapons, as well as various air-to-surface guided weapons. In total, more than 10 prototypes and pre-production vehicles were built, as well as three production Su-27Ms, and one prototype of an upgraded fighter trainer version. It is worth noting in particular that the Su-27M was being offered for export in the 1990s under the name "Su-35," which is still occasionally confused with the modern Su-35S.[15]

The project for further development of the Su-27M was also cancelled at the solo prototype stage. That version included an engine with controlled thrust vector and even more advanced avionics. This aircraft was being offered for export as the Su-37.

Meanwhile, against the background of underfunding, the number of operational Su-27s in the Russian Air Force was gradually decreasing, with the need for an upgrade of aircraft becoming more and more evident. The first major program in this field was the upgrade of some Su-27 fighters to the Su-27SM version in the 2000s. During the upgrade, the weapon control systems were improved, including the possibility to use new air-to-air missiles, guided bombs, and air-to-surface missiles. Also, multifunction displays were mounted on the instrument panel, a new L-150 radar warning station was installed, and other improvements were made. The Su-27SM began entering the Armed Forces in 2003, and by the end of the decade over 45 aircraft had been upgraded.[16]

The next stage of the modernization was the development of the Su-27SM(3) fighters, which are still the most advanced mass-produced version of the Su-27. In addition to the upgrade of weapon control systems, upgrade of communication and navigation systems, and installation of multifunction indicators and radar warning stations, the aircraft received more powerful AL-31F-M1 engines, the airframe structure was strengthened, and the number of hardpoints was increased.[17]

The first 12 Su-27SM(3)s delivered to the Russian Air Force under the contract signed in 2009 were new rather than upgraded aircraft. They were produced and delivered to the air force by the end of 2011 at the Komsomolsk-on-Amur Aircraft Plant. These aircraft were built using the

[15] Alexander Yermakov, "Su-35. Tret'ya seriya mirovogo blokbastera," *New Defence Order Strategy* magazine, 29 May 2019 (56), https://dfnc.ru/aviazcia/su-35-tretya-seriya-mirovogo-blokbastera/.

[16] "Suhoj' podvodit itogi goda i prazdnuet 70-letie," Take-off magazine, July 2009 (55), http://www.take-off.ru/pdf/07_2009.pdf.

[17] "Su-27SM3," Ugolok neba aviation encyclopedia, http://www.airwar.ru/enc/fighter/su27sm3.html.

technological reserve available at the plant. This was followed by a test upgrade of two Su-27Ps to the Su-27SM(3) variant, which was completed by 2014, followed by a contract for the upgrade of 10 more Su-27SM(3)s, which was completed only in 2018.[18]

At that point, the modernization of the existing Su-27s de facto stopped. The fate of the remaining unmodernized Su-27s (as well as the quantity of such operational aircraft) remains unclear and is subject to debate.

Su-30SM/M2

The fate of the Su-30 has been full of interesting twists. The original version of the Su-30 (Su-27PU) was initially developed in the late 1980s on the basis of the Su-27UB, with the aim of creating an improved two-seat fighter-interceptor for Air Defense Forces. Mass production started at the Irkutsk Aviation Plant in the early 1990s, but because of the collapse of the USSR and the growing economic crisis in Russia, it progressed very slowly and fewer than 10 aircraft were built (the armed forces received only five of them). In recent years these fighters have been undergoing major overhaul at the 275th Aircraft Repair Plant (Krasnodar).[19]

Later, the export variants of the Su-30 aircraft (Su-30K, Su-30MK, Su-30MK2, and their modifications) achieved huge success on the global arms market. In total, between the 1990s and 2019, over 630 Su-30 aircraft of various modifications were produced.[20]

The contract with India for the development of the Su-30MKI, its procurement by India, and the establishment of licensed production there played a special role. It allowed Russia to develop a modern multirole fighter capable of using guided air-to-air and air-to-surface weapons and to put it into mass production. The fighter obtained such features as the Bars radar with passive electronically scanned array (PESA), and the AL-31FP engine with thrust-vector control.

The Su-30MKI served as the basis for the aircraft that were procured by the Russian armed forces. That modification was named "Su-30SM" and is also produced in Irkutsk. The fighter was adapted to meet the requirements of the Russian Air Force in terms of radar, radio

[18] "Vse modernizirovannye istrebiteli Su-27SM3 Minoborony poluchilo soglasno kontraktuizgotovitel'," Interfax-AVN, 26 Feb. 2019, https://www.militarynews.ru/story. asp?rid=1&nid=502707&lang=RU.

[19] "Vosstanovlenie istrebitelej Su-30 (Su-27PU)," bmpd blog, 28 Mar. 2019, https://bmpd.livejournal.com/3586528.html.

[20] Alexander Yermakov, "Mirovoj rynok istrebitelej," *New Defence Order Strategy* magazine, 26 Aug. 2019 (58), https://dfnc.ru/aviazcia/mirovoj-rynok-istrebitelej/.

communications systems, friend-or-foe identification system, weapons configuration, ejection seat, and a number of auxiliary systems.[21]

The first two contracts for the production of a total of 60 Su-30SMs for the Russian Air Force were signed in March and December 2012, and deliveries of the first fighters started the same year.[22] Deliveries of Su-30SMs for the Russian Navy started in 2014 under the contract signed in 2013.[23] This was followed by new contracts. As a result, by the beginning of 2019, the 114 Su-30SM fighters were delivered to the armed forces. In 2020, a new contract on procurement of 21 Su-30SM2s (upgraded version of the Su-30SM with AL-41F-1S engines and other improvements) was signed.[24]

Meanwhile, on the basis of the Su-30MK2 export fighter, the Su-30M2 multirole fighter was developed. It was produced at the Komsomolsk-on-Amur Aircraft Plant and procured by the Russian Air Force. This aircraft can also use a wide range of guided and unguided aircraft weapons to engage air, ground, and sea targets, but it is not equipped with the PESA radar, an engine with thrust-vector control, or certain other features, which means that it is generally less advanced than the Su-30SM.[25] This fact has determined very limited procurement of the Su-30M2. Only 20 Su-30M2s were delivered under contracts that concluded in 2009 and 2012.[26]

Su-35S

The improvement in the Russian economic situation in the 2000s enabled the Sukhoi Design Bureau to return to the development of a new multirole fighter based on the Su-27. It was supposed that all the latest technologies and developments gained during the years of work on the family of these fighters would be combined, thus achieving superiority over all the fourth-

[21] "Su-30SM's fielding to start in autumn," *Take-off* magazine, Nov. 2013, https://web.archive.org/web/20140904202132/http://en.take-off.ru/pdf_to/to28.pdf.

[22] "Podpisan kontrakt na postavku v VVS Rossii ocherednoj partii mnogocelevyh istrebitelej Su-30SM," Ministry of Defense of Russian Federation, 19 Dec. 2012, https://function.mil.ru/news_page/country/more.htm?id=11539487@egNews.

[23] "Pervye Su-30SM dlya VMF Rossii," bmpd blog, 22 July 2014, https://bmpd.livejournal.com/928771.html.

[24] Alexei Nikolsky, "Minfin i «Roskosmos» vstupili v publichnye prepiratel'stva o sokrashchenii raskhodov," Vedomosti, 26 Aug. 2020, https://www.vedomosti.ru/politics/articles/2020/08/25/837739-minfin-roskosmos?fbclid=IwAR1wRj83P7hMPQkB1TB26OALx0vCmO6ah71M2zHRFQgUoRQ2-cgMfaNlyfY.

[25] "Su-30M2," *Ugolok neba aviation encyclopedia*, http://www.airwar.ru/enc/fighter/su30m2.html.

[26] "VKS Rossii poluchili poslednie dva istrebitelya Su-30M2," bmpd blog, 9 Apr. 2016, https://bmpd.livejournal.com/1839328.html.

generation fighters existing worldwide. This implied the need to introduce the new AL-41F-1S engine with thrust vector control, the new Irbis PESA radar, the OLS-35 infrared search and track (IRST) system, the Khibiny electronic countermeasures system, and many other features. Nevertheless, this fighter was to be cheaper and easier to produce than the fifth-generation fighter, which was under development at the time.

The first prototype of the new Su-35 performed its maiden flight in 2008. In 2011, mass production of the Su-35S began at the Komsomolsk-on-Amur Aircraft Plant. Under the first contract, concluded in 2009, 48 Su-35S fighters were procured for the Russian Air Force, with deliveries under the first contract to be completed by the end of 2015. The Russian Ministry of Defense signed a new contract for the delivery of another 50 Su-35S.[27] It is expected that the last 10 out of 98 Su-35Ss ordered under these two contracts will be delivered in 2020.[28] In August 2020, a new contract for production of 30 Su-35S fighters was signed during the Army-2020 military exhibition.[29]

The possibility of further procurement of Su-35Ss for the Russian Ministry of Defense probably depends now on the production volumes of the latest fifth-generation Su-57 fighters, the mass production of which started at the same plant in Komsomolsk-on-Amur.

Su-33

The carrier-based version of the Su-27 (Su-27K) fighter, named "Su-33," deserves a separate mention, although very few of them are left in service. This aircraft was developed and tested in the 1980s. The Su-27's design has undergone considerable changes. The Su-33 carrier-based fighters differ from the conventional Su-27s by featuring a wing-folding system, stabilators, canards, reinforced undercarriage, a tailhook, and other improvements.

The mass production of the fighter was launched during the heavy crisis and the subsequent collapse of the USSR. Therefore, only one aircraft carrier designed for the aircraft with the conventional horizontal take-off and landing was built and adopted by the Soviet Navy. Russia

[27] Alexei Nikolsky, "Ministerstvo oborony Rossii zakupilo 50 istrebitelej Su-35 na summu svyshe 60 mlrd rublej," Vedomosti, 10 Jan. 2016, https://www.vedomosti.ru/politics/articles/2016/01/11/623419- 50-istrebitelei-su-35.

[28] "Gruppa «Russkie Vityazi» poluchila eshche chetyre istrebitelya Su-35S," bmpd blog, 11 July 2020, https://bmpd.livejournal.com/4084207.html.

[29] Alexei Nikolsky, "Minfin i «Roskosmos» vstupili v publichnye prepiratel'stva o sokrashchenii raskhodov," Vedomosti, 26 Aug. 2020, https://www.vedomosti.ru/politics/articles/2020/08/25/837739-minfin-roskosmos?fbclid=IwAR1wRj83P7hMPQkB1TB26OALx0vCmO6ah71M2zHRFQgUoRQ2-cgMfaNlyfY.

acquired the ship, named Admiral Flota Sovetskogo Soyuza Kuznetsov, during the collapse of the Soviet Union, and it is still the only Russian aircraft carrier. Thus, the production of carrier-based fighters for Naval Aviation in the 1990s was limited to only 26 Su-33 fighters.[30]

Some Su-33s have been lost over the past decades, but the remaining aircraft continue to be operated and repaired as necessary. Even the production of the AL-31F Series 3 engines, which are mounted on the Su-33,[31] was resumed in 2017 to replace the old engines during the repair.

In the last few years, some of the Su-33s have been upgraded, which, according to official reports of the Russian Ministry of Defense, enables the aircraft to engage air, land, and sea targets with a high efficiency. The modernization includes installation of the SVP-24-33 Gefest sighting and navigation system.[32]

Su-57 fifth-generation fighter

The first activities towards developing fifth-generation fighters began in the 1980s, but the collapse of the USSR, the economic crisis, and underfunding delayed the start of full-scale R&D programs for many years. Thus, the Su-57 development program began only in 1999, when the Sukhoi Design Bureau initiated work on the development of a new-generation fighter. In 2001, the requirements for the PAK FA (Perspektivny Aviatsionny Kompleks Frontovoy Aviatsii, or "prospective aeronautical complex of front-line air forces") were specified, and in 2002, the Sukhoi Design Bureau's design won the Ministry of Defense competition.[33]

It took many years to implement the ideas into a real aircraft, so the first flying prototype of the aircraft did not make its maiden flight until 2010. After that, a lot of time was spent in testing and modifying the aircraft, which delayed the start of mass production by several years (that was not surprising, given the complexity of the work).

The Su-57 fighter incorporates the most advanced developments of the Russian aviation industry: a supercruising mode; stealth technologies; omnidirectional and multichannel

[30] "Prodolzhenie «dvadcat' sed'mogo»: pyat' luchshih samoletov na osnove Su-27," Rostec Coroporation, 21 May 2020, https://rostec.ru/news/prodolzhenie-dvadtsat-sedmogo-pyat-luchshikh-samoletov-na- osnove-su-27/.

[31] "ODK vozobnovlyaet proizvodstvo dvigatelej dlya palubnyh istrebitelej Su-33," RIA Novosti, 3 Oct. 2016, https://ria.ru/20161003/1478351805.html.

[32] "Partiyu istrebitelej Su-33 oborudovali special'noj vychislitel'noj podsistemoj," Ministry of Defense of Russian Federation, 3 Dec. 2017, https://structure.mil.ru/structure/forces/air/news/more.htm?id=12153428@egNews.

[33] "Istrebitel' Su-57," TASS, https://pakfa.tass.ru/istoriya-razrabotki-su-57/.

weapons application against air, ground and sea targets; and other criteria of the fifth-generation fighter. The aircraft is equipped with the most advanced Russian avionics, including radar with active electronically scanned array (AESA).

After a long period of development, the contract for the delivery of the first two aircraft for the Russian VKS was signed only in 2018. This was followed by the signing of the major contract for the delivery of another 76 Su-57s in 2019, which is to be fully implemented before 2028.[34]

Thus, during the upcoming few years, a total of 78 Su-57s are to be delivered to the Russian VKS. The first fighter was supposed to be delivered by the end of 2019, but because of the crash of the first fighter during the manufacturer's trials,[35] the schedule was postponed.

The first Su-57s will be delivered to the armed forces with the so-called AL-41F-1 engines of the first stage, but work on the new-generation engine is actively in progress and testing of the upgraded version of the Su-57 with new Izdelie 30 engines is expected to begin in summer 2022.[36]

Su-34 fighter-bomber

The twin-seat Su-34 fighter-bomber, is another aircraft of the Su-27 family. The development of the Su-27 variant designed primarily to attack ground and sea targets, i.e., Su-27IB, began in the 1980s, and the maiden flight of the prototype was conducted in 1990. In the 1990s, the aircraft was named "Su-34." Compared to the Su-27 family fighters, the Su-34 has a greatly redesigned configuration with an armored cockpit for side-by-side seating of its two-man crew. The other clearly visible features are a large central tail boom with an auxiliary power unit, a braking parachute, a small rear-facing radar antenna, as well as an additional fuel tank. The aircraft features enhanced survivability and a wide range of different guided and unguided weapons, including various guided missiles and bombs to engage ground and sea targets. The avionics include a PESA radar, an integrated electro-optical fire control system, and a set of electronic countermeasures.[37]

[34] "Istrebitel' Su-57," TASS, https://pakfa.tass.ru/istoriya-razrabotki-su-57/.

[35] "Razbivshijsya Su-57 byl pervym serijnym obrazcom," Interfax, 24 Dec. 2019, http://www.interfax.ru/russia/689131.

[36] Anton Lavrov, Roman Kretcul, "Vyjdet 'Super-Suhim': istrebitel' Su-57 ozhidaet modernizaciya," Izvestia, 26 June 2020, https://iz.ru/1028035/anton-lavrov-roman-kretcul/vyidet-super-sukhim- istrebitel-su-57-ozhidaet-modernizatciia.

[37] Su-34 specifications from Sukhoi official website, https://www.sukhoi.org/products/samolety/254/.

Mass production of the Su-34 as the replacement of Su-24M frontline bombers started in 2006, when the first contract was signed for the procurement of five aircraft for the Russian Air Force. These Su-34s were produced in 2006-2009 at the Novosibirsk Aircraft Production Association Plant named after V.P. Chkalov.

This was followed by the signing of a contract for the procurement of 32 Su-34s for the Russian Air Force in 2008, and another 92 Su-34s in 2012 for the period until 2020.[38]

In July 2020, the last two aircraft built under the 2012 contract were delivered to the armed forces.[39] Thus, 129 Su-34s were delivered to the troops under the 2006, 2008, and 2012 contracts. At the same time, it was reported in June 2020 that the Ministry of Defense signed a three-year contract for the production of an additional 24 modified Su-34 fighter-bombers with changes made on the basis of operational experience.[40] It plans to sign a contract in 2021 for the significantly upgraded version of the aircraft, the Su-34M.[41]

Su-24 frontline bombers and Su-25 attack aircraft

Before the launch of the Su-34 fighter-bombers' mass production, the Su-25 ground attack aircraft and Su-24 frontline bombers of various modifications were the backbone of the striking power of the Russian Air Force tactical aviation. While the plans for building 129 Su-34 bombers were being conducted right on schedule, the outdated Su-24M bombers were also being upgraded. It is known that until 2009 the aircraft were upgraded to the Su-24M2 level.

This upgrade package included the installation of new navigation equipment and avionics, which allowed the aircraft to use modern guided munitions (including X-31 and X-59 missiles).[42]

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[38] Andrey Fomin, "Na sborke – sotyj Su-34," *Take-off* magazine, 19 Aug. 2016, http://www.take- off.ru/item/2207-na-sborke-sotyj-su-34.

[39] "VKS Rossii poluchili poslednie dva frontovyh bombardirovshchika Su-34 po kontraktu 2012 goda," bmpd blog, 2 Aug. 2020, https://bmpd.livejournal.com/4103348.html.

[40] "Pervyj novyj Su-34 po novomu kontraktu," bmpd blog, Sept. 2020, https://bmpd.livejournal.com/4132605.html.

[41] "Minoborony podpisalo trekhletnij kontrakt na stroitel'stvo okolo 20 frontovyh Su-34," TASS, 8 June 2020, https://tass.ru/armiya-i-opk/8676891.

[42] "'Suhoj' zavershil modernizaciyu Su-24 dlya VVS Rossii," Lenta.ru, 10 Dec. 2009, https://lenta.ru/news/2009/12/10/su24m2/.

However, after evaluating the combat employment of the upgraded aircraft during the war with Georgia in 2008, the Russian Ministry of Defense decided to stop further upgrades of the Su-24M bombers to the Su-24M2 variant. Instead, it continued upgrading the Su-24M to the cheaper Su-24M Gefest variant.[43] The upgrade included the installation of the SVP-24 Gefest sighting and navigation system, allowing more accurate bombing with unguided munition. According to statements made by Russian military officials, during the air operations, the Su-24M2 and Tu-22M3 with the SVP-24 installed, achieved bombing accuracy comparable to that of guided ammunition, despite the use of the unguided gravity bombs.[44] Of course, such statements are very doubtful, and too many factors which cannot be calculated and considered may influence the accuracy of bombing with unguided gravity bombs. However, the use of the Gefest should noticeably improve the accuracy of bomb strikes.

Because of the ongoing production of the Su-34, the complete replacement of the Su-24 can be expected in the near future.

As for the attack aviation, the Su-25, which has been undergoing a series of upgrades since the mid 2000s, continues to serve as its backbone. Beginning in 2006, the troops have been supplied with the aircraft that were upgraded to the Su-25SM variant. This upgrade included installation of the PrNK-25SM Bars sighting and navigation system and a number of other systems, which improved the accuracy of unguided munition application and expanded the range of available guided missiles.[45]

As of 2016, the existing aircraft in the Su-25 fleet are being modified to the Su-25SM3 variant. The upgraded aircraft have a new SOLT-25 sighting-navigation system, the Vitebsk-25 electronic countermeasures suite, and the SVP-24-25 sighting and navigation system, among other things. According to Interfax-AVN sources, the entire Russian attack aircraft fleet, which is estimated at about 200 Su-25s (including the previously upgraded Su-25SMs), may undergo this modernization.[46]

[43] "Su-24M 'Gefest'," bmpd blog, 29 June 2012, https://bmpd.livejournal.com/273025.html.

[44] "Novaya sistema "Gefest" pozvolyaet ispol'zovat' nekorrektiruemye boepripasy kak vysokotochnye," TASS, 25 Aug. 2017, https://tass.ru/armiya-i-opk/4507779.

[45] Yurij Andreev, "Ne'SU'shchij smert' vragu," *Krasnaya Zvezda*, 17 Jan. 2007, http://old.redstar.ru/2007/01/17_01/2_02.html.

[46] "Chetyre novejshih shturmovika Su-25SM3 'Supergrach' popolnili aviacionnuyu chast' na Stavropol'e," Interfax-AVN, 18 Apr. 2019, https://www.militarynews.ru/story.asp?rid=1&nid=506361&lang=RU.

In total, 84 aircraft have been upgraded to the Su-25SM variant (including prototypes).[47] By early 2018, two prototypes and 14 mass-produced aircraft had been upgraded to the Su-25SM3 variant, and the modernization is currently underway.[48]

MiG-31 interceptors

The MiG-31 supersonic interceptor aircraft began to enter service for the USSR Air Defense Forces in 1980 and until the first half of the 1990s were produced at the Gorky aircraft building plant named after Sergo Ordzhonikidze (now called the Sokol Aircraft Plant). These—in many ways, unique—aircraft were designed as a further development of MiG-25 interceptors and were created primarily to patrol and protect the airspace of the USSR at a significant distance from air bases, which was necessary for many regions of the country. This determined their specifications, such as large size, high speed, high combat range, usage of long-range air-to-air missiles, and installation of powerful Zaslon PESA radar to detect and engage targets at a considerable distance. In fact, the MiG-31 was the first serial fighter to receive PESA radar.[49]

After the collapse of the Soviet Union, MiG-31s remained in service only in Russia and Kazakhstan. Because they continue to be valuable, Russia is upgrading its entire fleet of aircraft of that type. The serial modernization of the existing MiG-31B (MiG-31BS) into the MiG-31BM (MiG-31BSM) variant—which includes modernization of the avionics, communication, and navigation systems—has been carried out since 2007, mainly at the Nizhny Novgorod Sokol Aircraft Plant. Some aircraft were upgraded at the 514th Aircraft Repair Plant in Rzhev. Under contracts signed in 2011 and 2014, 113 aircraft[50] were upgraded at Nizhny Novgorod alone; considering previous contracts and work at the Rzhev plant, the total number of the upgraded vehicles is about 150.[51]

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[47] "Chetyre novejshih shturmovika Su-25SM3 'Supergrach' popolnili aviacionnuyu chast' na Stavropol'e," Interfax-AVN, 18 Apr. 2019, https://www.militarynews.ru/story.asp?rid=1&nid=506361&lang=RU.

[48] "Modernizaciya eshche vos'mi shturmovikov Su-25 v variant Su-25SM3," bmpd blog, 4 May 2018, https://bmpd.livejournal.com/3184641.html.

[49] Istrebitel'-perekhvatchik MiG-31. Letno-tekhnicheskie harakteristiki," RIA Novosti, 14 Dec. 2013, https://ria.ru/20131214/984063920.html.

[50] "Zamestitel' Ministra oborony Yurij Borisov pribyl s rabochej poezdkoj v Nizhnij Novgorod," Ministry of Defense of Russian Federation, 13 Oct. 2016, https://function.mil.ru/news_page/country/more.htm?id=12099552.

[51] "Novyj kontrakt na modernizaciyu istrebitelej-perekhvatchikov MiG-31," bmpd blog, 9 Jan. 2019, https://bmpd.livejournal.com/3488166.html.

In early 2019, it was revealed that a new contract for the modernization of another batch of MiG-31s into MiG-31BMs had been signed. In August 2018, United Aircraft Corporation (UAC) president Yuri Slusar said that in the next few years the VKS would receive several dozen more upgraded MiG-31BMs and that by 2023 the entire existing fleet of these interceptors would be upgraded.[52]

Some MiG-31s were modernized as a special variant, and they deserve a separate word. As a result of this upgrade, they become carriers of Kinzhal hypersonic ballistic missiles, designed to attack sea and ground targets using conventional or nuclear warheads. By May 2018, the armed forces received 10 such upgraded MiG-31Ks. There are plans to supply at least one more military unit with such aircraft before 2024.[53]

The ongoing upgrades are also expected to significantly extend the life cycle of the aircraft built in the 1980s and early 1990s, so that they can remain in service at least until the mid 2030s.[54]

Tactical aviation munitions

Russian tactical aviation has a wide range of guided and unguided munitions. However, despite the supply of new weapons, the armed forces still have a large number of quite old munitions. The standard air-to-air armament of the Russian fighter jets currently includes R-27 or R-77-1 (RVV-SD) medium-range missiles and R-73 or R-74 (RVV-MD) short-range missiles. A special case is the MiG-31 interceptor: its standard weapons include R-33 or R-37M (RVV-BD) long-range missiles.

Unguided aircraft rockets and bombs remain the most common munitions for attacking ground targets. As noted above, to improve the accuracy of the bomb strikes with unguided weapons, the old aircraft receive the SVP-24 Gefest sighting and navigation system during the modernization. However, a wide range of guided bombs and missiles for engaging ground and sea targets are also in service. Some of them—such as variants of the KAB-500 and KAB-1500

[52] "Novyj kontrakt na modernizaciyu istrebitelej-perekhvatchikov MiG-31," bmpd blog, 9 Jan. 2019, https://bmpd.livejournal.com/3488166.html.

[53] "Rossijskie voennye soobshchili o planah razmeshcheniya dal'nih perekhvatchikov s kompleksom 'Kinzhal' v Krasnoyarskom krae," Interfax-AVN, 27 Feb. 2020, https://www.militarynews.ru/story.asp?rid=1&nid=527841&lang=RU.

[54] Anton Lavrov, Roman Kretcul, "I dlitsya MiG: nachaty raboty po uvelicheniyu sroka sluzhby perekhvatchika," Izvestia, 22 July 2020, https://iz.ru/1038711/anton-lavrov-roman-kretcul/i-dlitsia- mig-nachaty-raboty-po-uvelicheniiu-sroka-sluzhby-perekhvatchika.

guided bombs, and the Kh-25 and Kh-29 tactical missiles—are in active use during the military operation in Syria.[55]

[55] Anton Lavrov, "Umnaya, sputnikovaya, vysokotochnaya," *Izvestia*, 5 July 2018, https://iz.ru/762685/anton-lavrov/umnaia-sputnikovaia-vysokotochnaia.

Strategic Aviation

Modernization of the Tu-22M3 and Tu-95MS

The striking force of the Russian Long-range Aviation is formed by Tu-22M3 long-range bombers, as well as Tu-95MS and Tu-160 strategic bombers. Though production of the Tu-22M3 and Tu-95MS was completely terminated in the early 1990s, these aircraft now make up the vast majority of the Long-range Aviation. According to some estimates, it may include about 55 Tu-95MSs and a few dozen Tu-22M3s,[56] which can still be operated for many years and therefore are being upgraded.

Since late 2009, within the framework of the Tu-95MS strategic bombers' upgrade, a program of overhaul and the first phase of aircraft modernization has been underway, providing the replacement of critical components, navigation equipment, and so on.[57] In addition, the upgraded aircraft can carry new Kh-101/102 long-range cruise missiles.[58]

Over the last few years, the Tu-95MS has been turned into the Tu-95MSM variant. The modernization provides a major upgrade of the avionics. Plans have been made to expand its capabilities to conduct optical and radio reconnaissance, and to improve its takeoff and landing performance. The contract for the development of Tu-95MSM was concluded in 2018. At the end of March 2020, the Tupolev company reported that it and the Taganrog Beriyev Aviation Scientific-Technical Complex together have completed the development of the first Tu-95MSM and begun testing the upgraded systems.[59] They expect to improve the performance of the

[56] Dmitry Litovkin, "Strategicheskij rezerv: kakoj potencial skryvaet dal'nyaya aviaciya Rossii?," TASS, 4 Mar. 2020, https://tass.ru/opinions/7897167.

[57] "Strategicheskij rezerv: kakoj potencial skryvaet dal'nyaya aviaciya Rossii?," official blog of United Aircraft Corporation, 26 Dec. 2016, https://uacrussia.livejournal.com/57594.html.

[58] "SMI: bombardirovshchiki Tu-95MS modernizirovany pod novejshie krylatye rakety Kh-101," TASS, 10 May 2016, https://tass.ru/armiya-i-opk/3268829.

[59] "Zaversheny raboty po sozdaniyu pervogo gluboko modernizirovannogo Tu-95MSM," Interfax, 30 Mar. 2020, https://www.interfax.ru/russia/701598.

aircraft by installing new NK-12MPM engines. The testing of the Tu-95MS with new engines is expected to be completed in 2020.[60]

As to the Tu-22M3, in the coming years we can expect the launch of the serial modernization of the aircraft under the Tu-22M3M program, which provides upgrade of avionics, installation of new navigation, communication and sighting equipment, engine and fuel consumption control systems, and equipment for electronic warfare. The aerial refueling system is returning as well.[61] The first prototype of the Tu-22M3M was modernized at the Gorbunov Kazan Aviation Plant and made its maiden flight in December 2018. The second prototype first flight was conducted in March 2020.[62]

Before that, some of the existing Tu-22M3s passed a limited modernization of avionics, which included the installation of SVP-24-22 Gefest sighting and navigation system,[63] which provides precise strikes with unguided bombs.

Restart of the Tu-160 strategic bomber production

The supersonic Tu-160 was the last mass-produced strategic bomber developed in the USSR. The planes entered service in 1987, but the following collapse of the USSR and the economic crisis led to a gradual termination of the Tu-160 production at the Kazan Aviation Plant in the 1990s. In addition, after the collapse of the Soviet Union, most of the Tu-160s were in Ukraine. Even after Russia was able to repurchase some of the Ukrainian aircraft against debts for natural gas, the Russian Air Force operated only 15 Tu-160s in early 2000s. Another Tu-160 was built from the existing Soviet technological reserve and delivered to the armed forces in 2008.[64]

[60] "Nazvany sroki okonchaniya ispytanij Tu-95MS s modernizirovannym dvigatelem," Zvezda, 25 Nov. 2019, https://tvzvezda.ru/news/opk/content/201911251027-s749L.html.

[61] "Vstrecha s glavoj Ob'edinyonnoj aviastroitel'noj korporacii Yuriem Slyusarem," President of Russia, 3 Aug. 2020, http://kremlin.ru/events/president/news/63852.

[62] "Vtoroj glubokomodernizirovannyj Tu-22M3M pristupil k poletam," Rostec Coroporation, 20 Mar. 2020, https://rostec.ru/news/vtoroy-modifitsirovannyy-tu-22m3m-pristupil-k-poletam/.

[63] "Bombardirovshchiki Tu-22M3 poluchat novyj bortovoj kompleks," Lenta.ru, 16 Aug. 2012, https://lenta.ru/news/2012/08/16/breo/.

[64] "Tu-160 - status, istochniki," Military Russia, 29 Jan. 2018, http://militaryrussia.ru/blog/topic- 271.html.

Later, some of the Tu-160 aircraft underwent limited first-phase modernization, during which they received a new navigation system, autopilot, and other upgrades; supposedly during this modernization, the new weapons (including new Kh-101/102 cruise missiles) were integrated.[65]

The program of further deep modernization of the Tu-160 into Tu-160M version was approved in 2014 and provides a serious upgrade of the avionics with the installation of a new radar, new flight control and navigation equipment, communication systems, Redut-70M self-defense systems, and other improvements. The first prototype of the Tu-160M made its maiden flight in February 2020.[66]

The upgraded Tu-160 will be equipped with new NK-32 series 02 engines, which are being developed by JSC Kuznetsov. These works are especially important because, besides the modernization of the existing Tu-160 bombers, it was decided to restart their mass production at the Kazan Aviation Plant. By the end of 2017, another Tu-160 was built in the limited modernization variant from the existing Soviet technological reserve.[67] It is not yet clear whether it has already been delivered to the armed forces or is still continuing its flight tests. In January 2018, a contract was signed for the construction of 10 new upgraded Tu-160M2 bombers, with deliveries beginning in late 2021.[68]

Prospective munitions

Currently, the primary munitions of Tu-95MS and Tu-160 strategic bombers are Kh-55SM and Kh-102 long-range cruise missiles equipped with nuclear warheads, as well as their conventional variants: Kh-555 and Kh-101. At the same time, the main munitions of the Tu-22M3 are still unguided gravity bombs and outdated Kh-22N antiship cruise missiles. In

[65] "Ministerstvo oborony Rossii poluchilo dva bombardirovshchika Tu-160 posle modernizacii," bmpd blog, 24 Apr. 2020, https://bmpd.livejournal.com/4004055.html.

[66] "Modernizirovannyj raketonosec Tu-160M sovershil pervyj polet," Rostec Corporation, 3 Feb. 2020, https://rostec.ru/news/modernizirovannyy-raketonosets-tu-160m-sovershil-pervyy- polet/?sphrase_id=207762.

[67] "Istochnik: novyj raketonosec Tu-160 nachal letnye ispytaniya na proshloj nedele," TASS, 24 Jan. 2018, https://tass.ru/armiya-i-opk/4898491.

[68] "Minoborony RF poluchit pervyj Tu-160M novoj postrojki v 2021 godu," Interfax, 25 Nov. 2019, https://www.interfax.ru/russia/685426.

addition, the Tu-22M3, Tu-95MS, and Tu-160 can carry Kh-15 aero-ballistic missiles, but according to some sources, these missiles have been retired.[69]

During the upcoming major upgrade of long-range aircraft, it is assumed that they will receive new weaponry. Thus, new X-32 antiship cruise missiles are already available for modernized Tu-22M3M long-range bombers, and tests of an unnamed air-launched hypersonic missile are underway.[70]

For the Tu-160M modernized bomber, a new long-range cruise missile is being developed. The only available information about it is that, according to the scientific adviser of the State Research Institute of Aviation Systems, Evgeny Fedosov, its firing range is much longer than the firing range of the Kh-101, which is 3,000 km.[71]

[69] Hans M. Kristensen, Matt Korda, "Russian nuclear forces, 2019," Bulletin of the Atomic Scientists 75, Issue 2 (4 Mar. 2019), https://www.tandfonline.com/doi/full/10.1080/00963402.2019.1580891; Alexey Ramm, "'Ubijcam avianoscev' popolnyat arsenal," Izvestia, 17 Nov. 2017, https://iz.ru/663570/aleksei-ramm/ubiitcam-avianostcev-popolniat-arsenal.

[70] "Istochnik: ispytaniya novoj giperzvukovoj rakety proshli s borta Tu-22M3," TASS, 11 May 2020, https://tass.ru/armiya-i-opk/8441847.

[71] "V Rossii razrabatyvaetsya aviacionnaya sverhdal'nyaya krylataya raketa," RNS Information Agency, 23 Feb. 2017, https://rns.online/military/V-Rossii-razrabativaetsya-aviatsionnaya-sverhdalnyaya- krilataya-raketa-2017-02-23/.

Attack Helicopters

After the collapse of the Soviet Union, the primary attack helicopter in the Russian armed forces was the Mi-24 in various modifications. Aircraft of this type soon became noticeably inferior to Western competitors in avionics and the use of modern guided missiles. In the 1980s, the USSR developed two new attack helicopters to replace the Mi-24: the Mi-28 and Ka-50. However, because of the technical problems that were revealed and the collapse of funding for development and procurement of new equipment in Russia in the 1990s, the basic Mi-28A was never mass produced and the Ka-50 was produced in a very limited series. By the end of 2000s, the redeveloped and upgraded variants of these helicopters, named "Mi-28N" and "Ka-52," entered mass production.[72]

Ka-52

The Ka-52 attack helicopter is an upgraded two-seat version of the Ka-50. It has been developed largely because some military officials objected to the single-seat layout of the Ka-50, where the functions of both pilot and gunner were performed by one person. The Ka-52 is produced at the Progress Arsenyev Aviation Company.

According to open sources, the first contract for the production of two prototypes and 24 serial helicopters for the Russian Air Force was signed in 2007 and production was completed by 2012. This was followed by a new contract, signed in 2011, for the production of 143 Ka-52 vehicles by 2020. Thus, 167 serial helicopters of this type were scheduled to be delivered to the troops by 2020.[73] A new multi-year contract on the procurement of 114 Ka-52M helicopters in a new upgraded variant can be signed in 2020.[74]

Furthermore, a ship-based Ka-52K helicopter was developed, which was originally intended to be deployed on Mistral-class amphibious assault ships. Because the contract was terminated

[72] Victor Litovkin, "Chernyj den' 'Chernoj akuly'," *Nezavisimaya Gazeta*, 12 Jan. 2009, https://nvo.ng.ru/wars/2009-01-12/2_blackshark.html.

[73] "Ministerstvom oborony Rossii planiruetsya zakupka eshche 114 vertoletov Ka-52," bmpd blog, 7 Feb. 2018, https://bmpd.livejournal.com/3083434.html.

[74] "Dolgosrochnyj kontrakt na modernizirovannye Ka-52M mogut zaklyuchit' v 2020 godu," TASS, 4 Dec. 2019, https://tass.ru/armiya-i-opk/7259043.

on procurement of the Mistrals, the production of the Ka-52K has so far been limited to four prototypes.[75]

Mi-28N

Mass production of the Mi-28N began at the Rostvertol helicopter plant in Rostov-on-Don in the mid 2000s, and, as far as is known, the first major contract for the supply of 67 Mi-28Ns to the Russian Air Force was signed in 2006. In 2010, another contract for the procurement of 30 helicopters was signed. Because production paused while the helicopters received necessary modifications, the new contract was signed only in 2016. It included the procurement of 24 Mi-28UB training and combat helicopters, which obtained mast-mounted radar. This radar significantly increased the operational capabilities of the helicopter, as well as the dual hydro-mechanical flight control system (which allows both crewmembers to operate the aircraft). The 16 Mi-28UBs under the 2016 contract are expected to be delivered to the troops in 2020.[76]

Production of another modernized version of the helicopter, the Mi-28NM, is also underway. The first two serial aircraft were delivered to the armed forces in 2019. Supposedly, eight Mi-28NMs were ordered under the contract signed in 2017. In 2019, a contract was signed for the delivery of 98 more Mi-28NMs to the military by 2027.[77]

Finally, according to Izvestia, there are plans to upgrade the existing Mi-28N fleet to a level comparable to that of the Mi-28NM.[78] The maiden flight of the upgraded helicopter prototype will likely take place in 2020.

[75] "V Rossii sozdali chetyre opytnyh korabel'nyh vertoleta Ka-52K," RIA Novosti, 30 Aug. 2019, https://ria.ru/20190830/1558065129.html.

[76] Anton Lavrov, Bogdan Stepovoy, "Ohota podeshevle: Mi-28N zhdet byudzhetnaya modernizaciya," Izvestia, 9 Apr. 2020, https://iz.ru/985802/anton-lavrov-bogdan-stepovoi/okhota-podeshevle-mi- 28n-zhdet-biudzhetnaia-modernizatciia.

[77] "Podpisan kontrakt na postavku Ministerstvu oborony Rossii 98 boevyh vertoletov Mi-28NM," bmpd blog, 29 June 2019, https://bmpd.livejournal.com/3692291.html.

[78] Anton Lavrov, Bogdan Stepovoy, "Ohota podeshevle: Mi-28N zhdet byudzhetnaya modernizaciya," Izvestia, 9 Apr. 2020, https://iz.ru/985802/anton-lavrov-bogdan-stepovoi/okhota-podeshevle-mi- 28n-zhdet-biudzhetnaia-modernizatciia.

Mi-35M

In addition to the production of the new Mi-28N attack helicopters, the Rosvertol company continues to produce an upgraded version of the Mi-24, named "Mi-35M," for a faster replacement of the aging fleet. According to open sources, the Ministry of Defense received 76 helicopters of this type in 2011-2017 under three contracts. After that, apparently a new contract was signed and deliveries resumed in 2019, when at least four new Mi-35M helicopters were supplied.[79]

[79] "'Vertolety Rossii' peredali VKS Rossii chetyre novyh vertoleta Mi-35M i dva Mi-28UB," bmpd blog, 28 Jan. 2019, https://bmpd.livejournal.com/3510479.html.

Conclusions

Since the second half of the 2000s, and especially during the last decade, Russia has procured new combat aircraft and helicopters and modernized its existing aircraft. The result is a significant upgrade of the Russian combat aviation fleet. According to the cited open sources, the Russian Air Force and Naval Aviation received a total of around 440 new combat aircraft (around 550 including Yak-130 jet trainers) in 2006-2019. Fixed-wing aircraft include the Su-30SM(3), Su-30SM/M2, Su-34, Su-35S, MiG-29SMT/UB, MiG-29K/KUB, MiG-35, and Tu-160; attack helicopters include more than 360 new Ka-52s, Mi-28N/UB/NMs, and Mi-35Ms. (See Table 1 and Table 2 at the end of this section.) Like any information data extracted from open sources, the data information may be incomplete and differ slightly different from the real figures, but it definitely demonstrates shows the general picture of the supply volumes.

Also note that the deliveries of new fixed- and rotary-wing aircraft included more than strictly combat vehicles. For example, between 2009 and 2018, 109 Yak-130 combat trainer aircraft were delivered to the Russian Air Force and further deliveries have been made. As for multi-purpose Mi-8 helicopters of various modifications, the total number delivered to the Russian Air Force for the period 2011-2017 is estimated at around 320. Given that new Mi-8 helicopters were being procured both before 2011 and after 2017, even more helicopters of this type were delivered to the troops.

In addition to the procurement of new aircraft, most of the MiG-31s still in service—as well as a significant number of Su-24s, Su-25s, Su-27s, and Su-33s—have been upgraded. Limited upgrades were also made to the Tu-22M3, Tu-95MS, and Tu-160 bombers, and their extensive modernization is expected in the future. Altogether, about 320 aircraft were upgraded. However, there is no information about the plans for modernization of the Mi-24 attack helicopters; thus, they may be maintained in operational condition until they are fully replaced by the new Ka-52, Mi-28N/UB/NM, and Mi-35M.

According to Russian deputy defense minister Alexey Krivoruchko, as of 2020, the share of modern weapons in the VKS has reached 75 percent. Between 2013 and 2018, more than 1,000 various (both combat and transport) new and modernized planes and helicopters were delivered to the armed forces.[80]

[80] "Vo vseoruzhii: rossijskaya armiya prodolzhaet obnovlenie," Rostec Corporation, 23 Mar. 2020, https://rostec.ru/news/vo-vseoruzhii-rossiyskaya-armiya-prodolzhaet-obnovlenie/.

At the same time, the procurement of new aircraft is insufficient to compensate for the overall reduction of the aircraft fleet that has already occurred. Due to the lack of open data, it is not possible to provide accurate information. However, the International Institute for Strategic Studies estimates that the Russian Air Force and Navy could have had around 2,000 fixed-wing combat aircraft and over 700 attack helicopters in the first half of the 2000s. For comparison, according to their estimates, in the late 2010s, the Russian Air Force and Navy had about 1,200 fixed-wing combat aircraft (a 40 percent reduction) and over 400 attack helicopters (a 43 percent reduction) in service. Although these estimates are not very accurate, they do convey a picture of a decline in the number of aircraft caused by the consequences of underfunding and large-scale reductions in the 1990s and early 2000s. According to these numbers, the approximate percentage of modern combat aircraft (not including jet trainers, transports, ISR aircraft, etc.) in service is as follows: 63 percent of fixed-wing aircraft and 90 percent of attack helicopters.

Moreover, the initial schedule for a number of programs (for example, the production of the Su-57 fifth-generation fighter) was too optimistic and delivery was postponed for a much longer period. That process has been further hampered since 2015, with the economic crisis and Western sanctions on Russia. Recently, there also has been a problem related to the lack of serial unmanned combat aerial aircraft, despite the existing programs for their development.

A separate issue is that Russian combat aviation includes many different types of combat aircraft and helicopters, as well as their variants. The most illustrative here, undoubtedly, is the simultaneous supply of three different models of attack helicopters to the troops, and the procurement of both Su-30SMs and Su-30M2s. This is primarily because of the state's desire to support various aircraft manufacturers. In Russia state-owned manufacturers are solving social issues by sustaining workplaces, and staff reduction, especially closure of a state enterprise, could lead to a serious scandal. The purchase of a small batch of MiG-35 fighters might be induced by the same reason: a decision to support RSK MiG. Finally, in some cases, there is a demand for a faster delivery of new aircraft to the troops.

However, despite the existing problems, the overall capacity of Russian combat aviation has increased significantly in recent years. The overwhelming majority of the Army Aviation now consists of new helicopters. The capacity of the strategic aviation has significantly increased because of modernization and rearming to new cruise missiles. The procurement of new aircraft and the modernization of the existing ones have increased not only the capabilities but also the flexibility of the tactical combat aviation fleet. For example, the Su-34 fighter-bombers have an incomparably greater capability to engage air targets than the Su-24 bombers they are replacing. In turn, the core of the fighter aircraft now consists of the Su-35S, Su-30SM, upgraded Su-27SM, and other aircraft capable not only of fighting for air supremacy but also of using precision-guided munition to engage ground and sea targets.

At the same time, despite the increase in the share of guided weapons, it is unlikely that the widespread use of unguided bombs and missiles by Russian aviation will be abandoned. The cost of new guided bombs and missiles remains significantly higher than that of unguided munitions, and there is still no Russian equivalent of the American Joint Direct Attack Munition (JDAM) guidance kit (which is a relatively inexpensive equipment set for converting standard unguided bombs into guided ones). The high cost of new armaments also hinders procurement of new types of air-to-air missiles. There are also certain problems in terms of the volume of munitions produced, despite the fact that plants are operating at full capacity.

The forthcoming delivery of the Su-57 fifth-generation fighters does not exclude the need for continuing procurement of the 4++ generation fighters. Russia's vast territory requires a significant aircraft fleet, and the high cost of fifth-generation fighters will not allow rearming the fighter fleet only with them in the foreseeable future. Thus, further procurement of Su-30 and Su-35 fighters is to be expected, even after completion of the contracts signed at the Army-2020 exhibition.[81] The procurement of Su-34 fighter-bombers for the replacement of the remaining Su-24 frontline bombers will also continue. At the same time, procurement of the MiG-35 light fighter is likely to be extremely limited. It will be done only in order to support the manufacturing plant and to show the potential foreign clients that it is a mass-produced aircraft.

Of course, further modernization and strengthening of the Russian combat aviation requires stable funding. Any instability in financing or major time gaps between the spending (for development and production) and payment will lead to the aviation industry being in debt to banks. For this reason, the old debts of the Russian United Aircraft Corporation to banks already amount to about 530 billion rubles, and the government's assistance has been needed to solve this problem. It is assumed that the government will now pay off a part of the debt of 250 billion rubles and restructure another part of the debt of 150 billion rubles. The fact that the Russian government regularly supports the defense industry is showing the lack of optimal management at many enterprises and regulatory issues related to the Ministry of Defense.

[81] Alexei Nikolsky, "Minfin i «Roskosmos» vstupili v publichnye prepiratel'stva o sokrashchenii raskhodov," Vedomosti, 26 Aug. 2020, https://www.vedomosti.ru/politics/articles/2020/08/25/837739-minfin-roskosmos?fbclid=IwAR1wRj83P7hMPQkB1TB26OALx0vCmO6ah 71M2zHRFQgUoRQ2-cgMfaNlyfY.

Table 1. Deliveries of fixed-wing aircraft in 2006-2019

Fixed-wing aircraft	Deliveries in 2006-2019
Su-30SM	114[a]
Su-30M2	20[b]
Su-35S	88[c]
Su-27SM(3)	12[d]
Su-34	127[e]
MiG-29SMT/UB	50[f]
MiG-29K/KUB	24[g]
MiG-35	2[h]
Tu-160	1-2[i]

[a] Alexander Yermakov, "Na odnom kryle: Su-30 stanovitsya «edinym samoletom» VVS stran ODKB," Izvestia, 25 Aug. 2019, https://iz.ru/913090/aleksandr-ermakov/na-odnom-kryle- su-30-stanovitsia-edinym-samoletom-vvs-stran-odkb.

[b] "VKS Rossii poluchili poslednie dva istrebitelya Su-30M2," bmpd blog, 9 Apr. 2016, https://bmpd.livejournal.com/1839328.html.

[c] Gruppa «Russkie Vityazi» poluchila eshche chetyre istrebitelya Su-35S," bmpd blog, 11 Jul. 2020, https://bmpd.livejournal.com/4084207.html; Alexey Nikolsky, "Minoborony podpishet soglashenie o zakupke 48 istrebitelej Su-35 na aviasalone MAKS-2015," Vedomosti, 10 Aug. 2015, https://www.vedomosti.ru/politics/articles/2015/08/11/604247-kontrakt- prodolzheniem.

[d] "Kontrakt na postavku modernizirovannyh istrebitelej Su-27SM(3) zavershen," bmpd blog, 1 Mar. 2019, https://bmpd.livejournal.com/3550821.html.[b] "VKS Rossii poluchili poslednie dva istrebitelya Su-30M2," bmpd blog, 9 Apr. 2016, https://bmpd.livejournal.com/1839328.html.

[e] "VKS Rossii poluchili poslednie dva frontovyh bombardirovshchika Su-34 po kontraktu 2012 goda," bmpd blog, 2 Aug. 2020, https://bmpd.livejournal.com/4103348.html.

[f] "Postavki boevyh samoletov v Vooruzhennye Sily Rossii v 2019 godu," bmpd blog, 16 Jan. 2020, https://bmpd.livejournal.com/3907389.html.

[g] "VMF Rossii poluchil 24 istrebitelya MiG-29K/KUB," Zvezda, 20 Jan. 2011, https://tvzvezda.ru/news/forces/content/201601201611-ermo.htm.

[h] "Postavki boevyh samoletov v Vooruzhennye Sily Rossii v 2019 godu," bmpd blog, 16 Jan. 2020, https://bmpd.livejournal.com/3907389.html.

[i] "Tu-160 - status, istochniki," Military Russia, 29 Jan. 2018, http://militaryrussia.ru/blog/topic- 271.html; "Istochnik: novyj raketonosec Tu-160 nachal letnye ispytaniya na proshloj needle," TASS, 24 Jan. 2018, https://tass.ru/armiya-i-opk/4898491.

Table 2. Deliveries of attack helicopters in 2006-2019

Attack helicopters	Deliveries in 2006-2019
Ka-52	167[a]
Mi-28N/UB	113[b]
Mi-28NM	2[c]
Mi-35M	80[d]

[a] "Ministerstvom oborony Rossii planiruetsya zakupka eshche 114 vertoletov Ka-52," bmpd blog, 7 Feb. 2018, https://bmpd.livejournal.com/3083434.html.

[b] Anton Lavrov, Bogdan Stepovoy, "Ohota podeshevle: Mi-28N zhdet byudzhetnaya modernizaciya," Izvestia, 9 Apr. 2020, https://iz.ru/985802/anton-lavrov-bogdan- stepovoi/okhota-podeshevle-mi-28n-zhdet-biudzhetnaia-modernizatciia; "Podpisan kontrakt na postavku Ministerstvu oborony Rossii 98 boevyh vertoletov Mi-28NM," bmpd blog, 29 June 2019, https://bmpd.livejournal.com/3692291.html.

[c] "VKS Rossii poluchili pervye dva serijnyh vertoleta Mi-28NM," bmpd blog, 24 June 2019, https://bmpd.livejournal.com/3684901.html.

[d] "'Vertolety Rossii' peredali VKS Rossii chetyre novyh vertoleta Mi-35M i dva Mi-28UB," bhhhmpd blog, 28 Jan. 2019, https://bmpd.livejournal.com/3510479.html.

This report was written by CNA's Strategy, Policy, Plans, and Programs Division (SP3).

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