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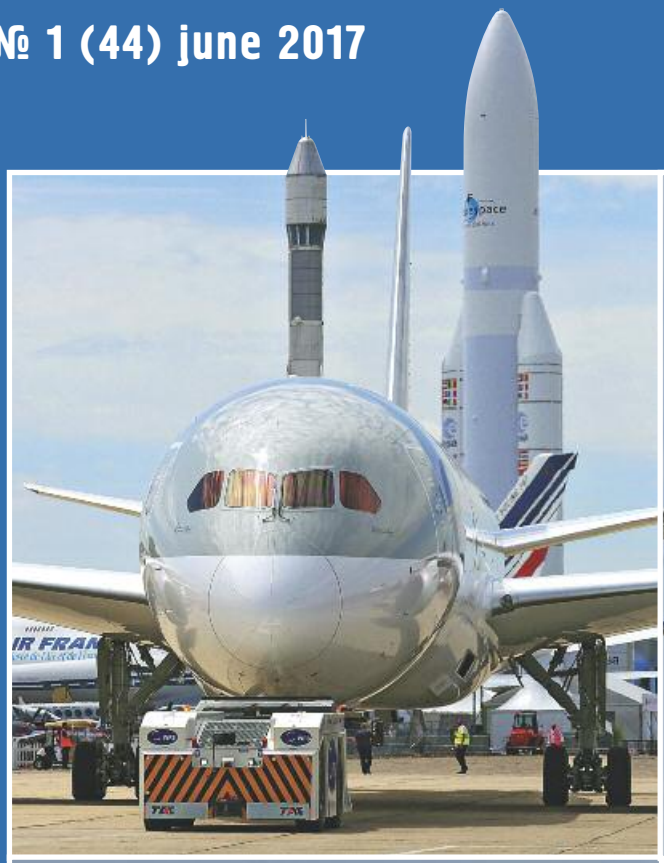
Russia & CIS Observer

№ 1 (44) june 2017



special focus on paris air show 2017

ShowObserver

ОБОЗРЕНИЕ ВЫСТАВКИ MAKS 2017

PUBLISHING DATES: July 18,19&20, 2017

DAILY NEWS PUBLICATION FOR KEY RUSSIAN AIR SHOW MAKS-2017

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Russia & CIS Observer

from the publisher of

ATO AIR TRANSPORT OBSERVER АВИАТРАНСПОРТНОЕ обозрение при участии AVIATION WEEK

№ 1 (44) june 2017

Russia/CIS Observer is produced by:

A.B.E. Media

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Irkut

Russia aiming to return to narrowbody market

The country's new MC-21 airliner first flew in late May

Maxim Pyadushkin

Russia is planning to make a comeback to the most profitable segment of the global commercial aircraft market with its new Irkut MC-21 narrowbody passenger aircraft. The first flying prototype took off in Irkutsk, Siberia at the end of May.

The first flight lasted for 30 minutes; the aircraft climbed to not higher than 1,000 meters and developed a maximum airspeed of 300 km/h, says OEM Irkut Corporation. The airplane was tested for stability and controllability. The aircraft also performed a go-around maneuver, then overflew the runway, climbed and turned.

The first flight went as planned, Captain Oleg Kononenko commented: "No obstacles to further tests have been revealed." First Officer Roman Taskayev confirmed that everything had performed nominally.

The MC-21 is Russia's first domestically designed commercial narrowbody aircraft since the collapse of the Soviet Union. The project was selected by the government in 2003 as the replacement for aging Tupolev Tu-154 and Tu-204 airliners.

The development effort was officially launched in 2007 by Irkut Corporation, a subsidiary of the United Aircraft Corporation (UAC). Like with Russia's first post-Soviet commercial aircraft program, the Sukhoi Superjet 100, the program is being led by a combat jet maker.

Despite the fact that Irkut by 2007 was running a very successful Sukhoi Su-30MKI multirole fighter production program, the manufacturer's aspirations went beyond the military sector. In 2004 it acquired Yakovlev Design Bureau, which had developed the Soviet-era Yak-40 and Yak-42 regional passenger jet types. Also in 2007, Irkut signed its first fuselage component supply contract for Airbus A320s.

The MC-21 draft design was approved in 2008. One year later, Irkut selected the primary suppliers for the program. This became Russia's second commercial aircraft effort involving broad international participation after the SSJ100.

In its maiden flight the MC-21 prototype was powered by Pratt & Whitney PW1400G-JM engines. This variant of the PurePower ultrahigh-bypas-ratio powerplant family develops 31,000 lb of thrust; it also powers the A320neo, the Bombardier CSeries, the MRJ, and the Embraer E2.

The aircraft's alternative, Russian-designed powerplant, the Aviadvigatel PD-14, has just completed initial trials on an Il-76LL testbed and will now enter certification tests. A Russian certificate is expected to be issued in 2018. Deputy Prime Minister Dmitry Rogozon has announced that a Russian-powered MC-21 could take off in 2019.

The MC-21's avionics suite was designed by the UAC but features components supplied by Honeywell, Thales, and Elbit Systems. Other foreign partners include Zodiac Aerospace, Eaton, Meggitt, and Goodrich. More foreign

suppliers have been involved into setting up the production line at Irkut's facility in Irkutsk, and also in delivering materials for production.

The foreign technologies involved in the program will be retained by Russia: Irkut demands that its partners localize aftersales maintenance of their components in the country. The Russian maintenance partners are to be identified by June this year.

The name MC-21 stands for Magistralny Samolet 21 veka (Mainline Aircraft of the 21st Century). It was selected to emphasize the innovative nature of the program. This will be the first Russian commercial aircraft to feature a high-aspect-ratio supercritical composite wing. Composites are also used in the wing box, vertical and horizontal stabilizers.

The wing box and outer wing are manufactured under a vacuum infusion technology at UAC subsidiary AeroComposit. During fatigue tests at the Central Aerohydrodynamics Institute (TsAGI) in February, the wing box developed cracks at the point of contact between the composite skin and the titanium beam. The remedy was to reinforce the wing on the first prototype prior to the first flight.

The avionics suite includes 9 x 12 inch MFDs, electronic flights bags, and also enhanced vision and synthetic vision systems. The MC-21 will also become the first Russian commercial airliner with active sidesticks, supplied by US-based United Technologies Aerospace Systems.

The first prototype, rolled out in June 2016, represents the MC-21-300 baseline version with 79,250 kg MTOW. It can carry up to 211 passengers to a distance of up to 6,000 km. The shorter, 72,560 kg MTOW variant, dubbed MC-21-200. will seat up to 165.

At the start of the MC-21 program, in the mid-2000s, the aircraft was expected to enter service in 2016. This was believed to result in the Russian airliner's high popularity worldwide, as Airbus and Boeing had not yet finalized their plans for new narrowbody products at that time. The timeline eventually slipped due to developmental holdups (both organizational and technical). In the meantime, competition has been mounting. Now it looks like the Russian aircraft will enter the market behind the Airbus A320neo, the Boeing 737 MAX, and, probably, even the COMAC C919, which might limit its potential sales.

Certification in Russia is now planned for 2018, to be followed by EASA certification in 2019.

The MC-21 backlog stands at 175 firm orders, mostly from Russian government-owned lessors, plus over 100 commitments. The launch operator is understood to be Russia's largest carrier, government-controlled Aeroflot. The carrier will receive its MC-21s via the local lessor Avia Capital Services. In April 2017, Russian media cited the Aeroflot CEO Vitaly Saveliev saying that the first delivery was expected in 2019.

Other customers include Russian lessors VEB Leasing, Sberbank Leasing, and Ilyushin Finance Company, as well as local carriers such as UTair Aviation, Red Wings, and IrAero.

The MC-21-300 baseline version can carry up to 211 passengers to a distance of up to 6,000 km

Irkut

VSMPO TITANIUM – ONCE AND FOREVER

Russia, China join forces to develop widebody airliner

Russia's UAC and China's COMAC have set up a joint venture to run the program

Maxim Pyadushkin

Russia's United Aircraft Corporation (UAC) and the Commercial Aircraft Corporation of China (COMAC) have taken another step toward the joint development of a new long-range widebody commercial airliner, dubbed the C929 in China. The partners officially opened the joint venture China-Russia Commercial Aircraft International Corporation (CRAIC) in Shanghai in May. The company will coordinate the parties' efforts on the program, which still has many important issues unresolved.

Marina Lysteva

The official opening of UAC-COMAC joint venture in Shanghai

UAC President Yury Slyusar described the establishment of CRAIC as the most important pragmatic step in the framework of the program: "We want to develop this widebody aircraft together, to organize its production, operations, aftersales support, marketing and sales, and so on."

Jin Zhuanglong, chairman of the board at COMAC, noted that the establishment of CRAIC marked an important milestone for the program: "We will cooperate sincerely with UAC, and strive to make the program a model of Sino-Russian cooperation. We will follow the latest international mainstream airworthiness standards, build more competitive long-range widebody aircraft, and strive to provide customers with better service and make new contributions to global aviation market."

The program, launched in 2014, is backed by an intergovernmental agreement between Moscow and Beijing signed two years later.

The JV board is chaired by UAC vice—president Vladislav Masalov, who is also president of UAC subsidiary Sukhoi Civil Aircraft Company (SCAC). SCAC will gradually take over control on all the UAC's commercial aircraft programs. Guo Bozhi, head of the widebody program at COMAC, is the CRAIC general manager. The partners have four members each on the board of the new JV.

The JV launch will enable the beginning of detailed design work on the new widebody, seeing as the sides have agreed on how the workload will be shared, Masalov explains. UAC and COMAC engineers have been working on the program in concert since 2013; now the development effort will be picked up by a joint engineering center, to be set up in Moscow in 2018 with a total of about 100 engineering personnel representing both countries.

The UAC will be responsible for the development of the composite wing, wingbox, wing flap systems, engine pylons, and main landing gear, Masalov notes. The Chinese party will work on the fuselage, empennage, nosecone, nose landing gear, and wing fairings.

Masalov says, the detailed design should be completed by the end of 2018, by which time the partners expect to have identified their major suppliers. Requests for information have been sent to 169 companies. Russian and Chinese companies will have priority, followed by foreign businesses with established joint ventures in either of the countries.

The UAC and COMAC have already held initial meetings with airlines and lessors on the future aircraft's priority market, which is believed to be China. The potential clients asked for the airliner to come with two powerplant options, Masalov says. The partners are in talks with General Electric and Rolls-Royce, while Russia's Aviadvigatel PD-35 might be offered at a later stage.

It is understood that the airframe will be at least 50% composite for lower

weight and higher performance. The aircraft is also expected to have improved aerodynamics, and to be "more electrical", although the final system choices have yet to be announced by the designers.

The baseline will have 280 seats and a range of 12,000 km. A shorter, 230-seat version is planned, as is a 320-seat stretch, but whether or not these ever materialize will depend on customer demand.

The UAC's Slyusar says the new widebody will help both companies fill the existing gap in their respective commercial product lines stretching from regional to long-range airliners. For the Russian manufacturer, the C929 is to replace the ageing Ilyushin Il-96 quad as the largest member of the product range that also includes the SCAC SSJ100 and the Irkut MC-21. The UAC intends to keep building the Il-96-400M version for government customers until the new Russian-Chinese widebody enters service.

COMAC, for its part, will use the C929 to fill the widebody gap in its product line, which currently is represented by the ARJ21 regional jet and the C919 narrowbody.

The partners are not making any official statements as to when they expect the airliner to enter service, saying only that the development and certification processes might take up to 10 years. The UAC and COMAC forecast a global demand for 7,000 widebody commercial aircraft in 2023-2045, to the tune of $1.5 trillion. The major part of this demand is expected to come from Asia-Pacific, China, Russia, and the CIS, Masalov remarks.

Even with the JV in place the partners have yet to agree on several important issues, and the talks are not going to be easy. The Russian side wants to maintain parity in every aspect of the program, while China is trying to get as much out of the deal as possible, as it is clearly focused on the domestic market at the moment.

COMAC has been proposing a branch of the engineering center to be set up in Shanghai, and has also been in favor of parallel certification in Russia and China. Guo Bozhi says a certification application is expected to be filed in 2019.

Masalov explains that, seeing as the UAC is the designated program integrator, the engineering part of the program is to be completed in Russia.

Another possible bone of contention is the manufacturing process. It has been agreed that final assembly will take place in Shanghai. Masalov hopes that the Russian side will at the very least be entitled to manufacture the components it is going to design. On the other hand, he says, the possibility cannot be ruled out that production of these components will be given to COMAC if the latter can manufacture them cheaper: "There is as yet no firm agreement on the component manufacturing distribution, the issue will be finalized closer to the production launch date."

UAC sets up a center for all civil programs


SCAC

Russia's United Aircraft Corporation (UAC) expanded the role of one of its primary civil assets, Sukhoi Civil Aircraft Company (SCAC), which is responsible for the Sukhoi Superjet 100 (SSJ100) regional jetliner program. Apart from the revision of the SSJ 100 program following the decision by strategic Italian partner Finmeccanica to reduce its participation, it was decided to use SCAC as a center that would manage all the UAC civil programs. SCAC's new president, Vladislav Masalov, told *Russia & CIS Observer* how the company will transform and what projects it will take on board.

— What tasks is SCAC facing now that the Italian partner has reduced its participation in the SSJ 100 project?

— Our only task is to ensure commercial sales of the aircraft. For this purpose we are intensifying work with potential operators and invest maximum effort in organizing aftersales support.

At the upcoming MAKS air show in Russia in July, we are planning to sign another SSJ100 contract with Aeroflot. Another major operator, Mexico's Interjet, will receive four airlines this year and another four in 2018. If we manage to coordinate a number of terms and conditions, Interjet will be prepared to sign a contract for 10 more aircraft.

We are currently in talks with GTLK State Transport Leasing Company over a remarketing scheme which, as our experience suggests, could be popular with regional airlines.

So the annual output of 35 airframes we are planning for the next several years is very much achievable.

— There are already many SSJ100s in operation. How are you going to develop aftersales support?

— I believe the artificial monopolization of the aftersales support services is the reason why operators have been having problems with the type. I will work to involve professional MRO providers in the process.

We hope to sign an agreement shortly with FL Technics, one of the leading MRO providers. It would organize base and line maintenance outstations for our aircraft and would be offering OEM services to European customers.

Another aspect of aftersales support is that we need to seriously expand the stock lists at our parts depots. I mean both our home-based stocks, which we are obliged to provide to customers, and consignment inventories at the operators' end. This will require sizable investments, up to 15 billion rubles [$263 million] at the initial stage.

We have also agreed with Interjet on component repairs at their technical base in Toluca. We selected 47 components they are prepared to repair, signed a license agreement, and handed over the relevant technical documentation to the operator.

— What will SuperJet International JV be doing?

— It will continue to customize SSJ100s for specific customers and deal with certification issues. All the exported airliners will be delivered to our Venice-based JV, which will install interiors, paint and fine-tune the aircraft.

The JV will also continue to run a training center.

SuperJet International employs a rather strong team of marketing consultants and sales managers, so it will continue to be responsible for sales. Only now the JV will have closer contacts with the SCAC commercial sector in Moscow. In the past 12 months we have taken part in all the talks held by the SuperJet International team.

— What will the UAC civil division's product line look like?

— Apart from the SSJ100, the Irkut MC-21, and the future Russo-Chinese long-range widebody commercial aircraft, it will also include the renovated Ilyushin Il-114 turboprop.

— How will the UAC civil programs be managed?

— Everything will be managed through SCAC. I am planning to incorporate the widebody aircraft and Il-114 into the renovated SCAC first, to be followed by the MC-21 at a later stage. We are already setting up a department within the SCAC design bureau that will be working on the widebody program. We need to bring the administrative functions, sales, and aftersales support up to the senior decision-making level, i.e. to set up a single customer support center for all civil aircraft programs. It could be set up on the premises of SCAC or as a standalone legal entity; we will decide later this year.

Seeing as we are incorporating new programs into SCAC, we will need to change the company name to a more generic one shortly. The rebranding decision, however, will be for the UAC to make.

This interview was prepared by Maxim Pyadushkin

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Artyom Anikeev / Transport-photo.com

PD-14 enters the home stretch

Artyom Korenyako and Evgenia Kolyada

In late May 2017, the Russian city of Irkutsk witnessed the maiden flight of the new-generation Irkut MC-21 airliner powered by US Pratt & Whitney PW1400G-JM engines. Shortly before the first flight, the United Engine Corporation (UEC) announced it had successfully completed the second stage of the flight trials on its newest PD-14 engine, the Russian alternative powerplant option for the country's long-awaited narrowbody aircraft.

"The tests completed mark a significant milestone in the PD-14 development program, allowing us to move on to the certification trials on the flying testbed, to be followed by engine flight tests with the MC-21," says UEC General Director Alexander Artyukhov. Certification of the new Russian-made engine is to be completed in 2018-2019.

The PD-14 program is currently in full swing. A total of 12 test engines have already been assembled, Artyukhov reported at the Russian Government Aviation Board meeting in early March. He emphasized that the program incorporates 16 critical technologies, allowing the PD-14 to compete with the latest-generation powerplants. The company continues assembling prototypes and fine-tuning them, including with the use of environment simulation tests inside a climatic testing chamber at the Gromov Flight Research Institute and on the institute's Ilyushin Il-76LL flying testbed.

"The engine has already demonstrated the design technical parameters," Artyukhov stressed. "We are also developing the nacelle as part of the project. This would normally be for the airframer to develop, but we are dealing with the challenge successfully. The PD-14's core can be used to develop engines for various other applications (for rotary- and fixed-wing aircraft, and also for industrial use) within short periods of time and with minimum risk."

In March this year, Alexander Inozemtsev, managing director and chief designer of UEC-Aviadvigatel, the PD-14 designer, pointed out that the program was progressing on schedule despite several remaining obstacles: "We are in the middle of multiple trials, and literally all our test benches in Perm are loaded with work. In a couple of days the engine will leave for Rybinsk again, to commence the next stage of open rig tests, which we have already been through once before. There is no doubt that the engine will be a success; our priority at the moment is to complete all the tests."

Inozemtsev added that the PD-14 was to achieve type certification in 2018, to be followed by EASA valida-

tion in 2019: "We are in cooperation with EASA experts; they have already visited our site and familiarized themselves with the situation. This so-called shadow certification means that they have been taking part in our [certification testing] work but have not so far signed any papers. They merely share advice so that later on, when we are ready to apply for [EASA] certification, we do not have to do some things again. Despite the overall positive impression, the EASA sees that we still have issues and there is much work left to be done. But the work is going on."

Powerplant for widebody

Another priority task for the Russian engine-makers is to create a 35- to 40-ton-thrust engine, Artyukhov points out. This is where the experience gained from the PD-14 program will become crucial. The company says the project should be based heavily on the know-how and technology involved in the PD-14 engine family program.

The Perm-based engine specialist is already involved in the so-called PD-35 program, which will use the PD-35 core as the basis for a family of heavy-duty powerplants. The 35-ton PD-35 bypass turbofan is viewed as the baseline for a family of 22- to 38-ton engines intended for future widebody airliners.

"Our design specifications for the future powerplant guarantee that it will be competitive and will meet the requirements for engines of 2025-2030," Artyukhov noted. We are conducting intensive R&D work as part of the program; we have already come up with eight core technologies and created the necessary infrastructure, as well as identifying a pool of participants, including various research and development facilities, design bureaus, and universities." He added that the implementation of this project would enhance the potential of Russian plane-makers, enabling them to build all types of aircraft: passenger airliners, freighters, or military transports.

In his March interview, Inozemtsev stressed that the PD-35 was still in the research and development phase, including deep analysis of the next technology cycle required to create the engine: "Everything created so far within the PD-14 program will be applied to the PD-35 project. But that will not be enough: scaled-up PD-14 technologies alone will not make the bigger engine competitive. There certainly are nuances that we have to bear in mind. We have to completely work through this second technology package in the next six years, and we invite a large number of academic and industrial facilities to join us in this effort. Our goal is introduce technologies that will make the PD-35 competitive, to demonstrate them on the prototype core and then on the demonstrator engine. In order to accomplish this, we will need to build test benches: at the moment there is no test rig for such a big engine in the country because the Soviet Union did not have powerplants of this size." ■

Kamov Ka-62 performs first flight

Russian Helicopters

Ka-62 is the first Kamov's non-coaxial rotor aircraft

The Kamov Ka-62 medium multirole helicopter has performed its maiden flight. The flying prototype lifted off from the airfield of Arsenyev-based Progress Company, a subsidiary of Russian Helicopters holding, on May 25, more than a year after the first hovering test.

According to Russian Helicopters, during the 15-minute flight the aircraft circled the airfield once, accelerating to 110 kph. The prototype was being tested for handling and stability, commented Russian Helicopters CEO Andrey Boginsky.

The Ka-62's flight test program was launched on April 28, 2016, when the helicopter made its first take-off. Before proceeding to horizontal flights, it performed multiple engine runups and hovering tests. The company is assembling two more flying prototypes, which will enter certification trials shortly.

Ka-62 medium twin is the first Kamov's non-coaxial rotor aircraft. It features a standard rotary-wing configuration with a single five-bladed main rotor and a shrouded tail rotor. The airframe incorporates a considerable share of composite materials for lower structural weight. The helicopter is powered by a pair of Safran Ardiden 3G turboshafts with 1,776 horsepower at takeoff. Another foreign component is the aircraft's transmission developed by Austrian specialist Zoerkler.

According to the manufacturer, the maximum carrying capacity of the aircraft is expected to make up 2,200-2,500 kg or 12 to 15 passengers, while the maximum takeoff weight will be 6,500 kg. The helicopter will have a maximum speed of 308 km/h and a cruising speed of 290 km/h. The range of the craft is set at 770 km with use of the main fuel tank.

The Russian Ministry of Industry and Trade sees the country's defense and law-enforcement sectors as the launch customers for the Ka-62. Russian Helicopters is planning to run a market study to see if the type has any potential demand among civilian operators. ■

Sukhoi boosts SSJ100 efficiency

Artyom Korenyako

In the beginning of June, Irish carrier CityJet received its sixth Russian-built Sukhoi Superjet 100 (SSJ100) regional aircraft. The airline is wet-leasing the jetliner to another European operator, Brussels Airlines.

This is one of the indications of the SSJ100 project being a success, even though Russia has so far sold fewer Superjets than initially planned. On the other hand, no one was expecting SSJ100 with their arms outstretched. The regional aircraft market is highly competitive; to occupy a decent place on it, the Russian manufacturer will need to invest a lot of time and effort.

Now, 10 years after the first SSJ100 presentation, OEM Sukhoi Civil Aircraft Company (SCAC) is preparing to build its 150th airframe. In the next five years the manufacturer is planning to deliver 170 to 180 aircraft (including in the business jet version), at a rate of 35-40 deliveries per year.

Brussels Airlines already operates three wet-leased Superjet 100 aircraft in its own livery

SuperJet International

The aircraft utilization by Mexico's Interjet serves as the benchmark, but the Russian operators' SSJ100s have not been operated as intensively. The average utilization rate of the Russian Superjet fleet stood at below 1,500 hours per airframe per year in 2011-15, or about four hours a day. Nevertheless, the share of passenger traffic served by these regional aircraft in Russia keeps growing steadily: from 0.4% in 2011 it climbed to 0.81% in 2015, and has by now exceeded the figures for other Soviet- and Russian-built airliners.

In parallel, SCAC continues to improve the aircraft and uses the experience gained in the course of the Superjet program in new Russian airliner programs. As of spring 2017, EASA and the Russian aviation authorities had approved 77 and 51 major modifications to the SSJ100 design respectively, not to mention a vast number of secondary changes which all combined to improve the aircraft's technical characteristics and performance dramatically, as well as enhancing its reliability and maintainability parameters. The SSJ100 will receive additional fuel tanks in the business jet version, will be cleared to operate under the ETOPS rules, perform steep approach landings, take off with predeployed flaps, etc.

"The main thing that Superjet brought to the Russian aircraft manufacturing industry is that it became a platform for developing other projects and an example of international cooperation," says Igor Vinogradov, the SCAC vice-president for certification. "It has eventually become a mass-produced aircraft operated in various countries under various conditions. At last we achieved something we had dreamed of. We have finally built an aircraft with which we will return on our investment. We have operating income in the offing already."

Vinogradov recalls that at the beginning of the project, the Voronezh and Ulyanovsk production factories, subsidiaries of Russia's United Aircraft Corporation – SCAC parent company, offered to launch SSJ100 series production. However, SCAC made the only right choice. "When discussing the SSJ100's influence on the Russian economy, one should keep in mind that the development of Siberia and the Far East is one of our government's priorities, says Vinogradov. — A dedicated modern plant was built in Komsomolsk-on-Amur to meet the needs of the SSJ100 program. The plant was certified by the European aviation authorities. It is capable of building 50 airframes per year. Creating a new production facility in the region was an important achievement. People in the Far East needed jobs that would bring them money and satisfaction. This problem was solved, in my opinion."

Now that the SSJ100 production issues have been generally resolved, SCAC is directing major resources to developing the aftersales service system. Those SSJ100 operators which also have experience operating foreign types legitimately expect a certain level of technical support. On the other hand, they all note that the situation has been improving gradually.

Russian titanium gains weight

Maxim Pyadushkin


VSMPO

VSMPO-AVISMA and Alcoa joined their competencies to manufacture large molded titanium- and aluminum-alloy parts for international aerospace manufacturers

VSMPO-AVISMA, Russia's leading manufacturer of aeronautical titanium, continues with its efforts to build up the output of high-refined products. The company has been developing joint projects with the leading international aircraft manufacturers. Its long-standing cooperation with Boeing is being elevated to a new level; a similar project is scheduled to be launched with Airbus shortly.

As VSMPO-AVISMA representatives told *Russia & CIS Observer*, the construction of the new production facility for the joint venture Ural Boeing Manufacturing (UBM) is nearing completion. The JV produces molded titanium parts for the US aircraft manufacturer.

The production and administrative buildings of the new facility will be completed this summer, with the volume of investment required for the project standing at 1.77 billion rubles ($207 million). The JV will be equipped with state-of-the-art metal cutting equipment, a VSMPO-AVISMA representative confirmed.

The facility, to be known as UBM-2, will process molded titanium parts for all of Boeing's civil aircraft programs, including the 787 family and the new 737 MAX and 777x types. The Russian corporation will enhance the processing depth and improve the technological level of production, supplying Boeing will products whose size will be close to that of the final parts. "The new types of aircraft require more titanium, so we are having more work to do," the VSMPO-AVISMA representative noted.

A similar project is to be implemented with Airbus. VSMPO-AVISMA has been discussing a machine processing JV with the French manufacturer's supplier Figeac Aero. "Together with our partners we will maintain a parity of shares in the JV," the VSMPO-AVISMA source said. — "A new production facility in the Titanium Valley special economic zone (in Sverdlovsk Region, Russia – *ed.*) is one of the ways to develop the JV, but in the first phase we are planning to use the existing capacities." The new plant is expected to become operational in 2019-2020; the partners are now actively searching for additional orders and preparing for production launch.

VSMPO-AVISMA reported a record growth in the output of deeply processed products in 2015. The output of the machine processing workshop grew by more than 50%. In 2016, the volume of molded parts grew by 3%. "In the future we are planning for molded parts to make up more than 40% of our total output," the company source said.

The launch of AlTi Forge, a joint venture between VSMPO-AVISMA and Arconic SMZ, became one of the 2016 milestones. Arconic SMZ is managed by Alcoa, an American aluminum manufacturer. The companies joined their unique and complementing technical competencies in producing large molded parts, and have already begun to manufacture first titanium- and aluminum-alloy products, such as landing gear and wing parts for international aerospace manufacturers.

The Russian corporation has been actively diversifying its production and expanding its product portfolio throughout the recent years. The key attention is being paid to the development of high-tech products based on deeply processed titanium alloys, including a large variety of molded parts, as well as thin sheets and tubes. VSMPO-AVISMA is now offering more than 400 types of molded parts on the international market and more than 1,500 types of molded parts on the Russian market; these figures keep growing as the corporation is taking an active part in all the new aviation programs. "The aviation market is stable and optimistic today, especially when it comes to the industry giants," the company source stressed. "We have long-term contracts with such companies, and this is certainly the main market for us."

Unmanned future for Russia

Artyom Anikeev / Transport-photo.com

Denis Fedutinov

After the 2008 conflict with Georgia, Russia became aware of the necessity for modern unmanned aerial systems (UAS). The conflict stimulated a range of development projects for unmanned aerial vehicles (UAV) of different classes. Currently, several of these projects are edging toward completion.

Tactical UAVs

One of the Russian UAV projects currently under development is the Korsar. The system, an apparent Russian equivalent to the US-developed Shadow, is being developed by Rybinsk-based Luch Design Bureau. It is planned as a surveillance vehicle, and will have a range of 50 km.

In parallel with the development effort, production has begun in Rybinsk. Aleksandr Yakunin, the CEO of the United Instrument Manufacturing Corporation (UIMC, a part of Rostec Corporation), announced in 2015 that trial examples of the Korsar would be delivered to the Russian army from the end of 2016. Series production was expected to begin in the first quarter of 2017. Media have reported that the Russian military was planning to test the Korsar in Syria, but an accident in the course of the flight testing program likely affected these plans.

MALE class

There are also projects underway to develop two medium-altitude, long-endurance (MALE) UAVs. The vehicles were originally expected to have a takeoff weight of 1 and 5 tons. The similarity of their size and weight to the US Predator and Reaper suggests that their functions would also be similar. The MALE aircraft will likely be able to perform long-duration flights of over 24 hours, in addition to carrying observation and intelligence-gathering equipment and weapons.

One of the systems is currently being developed by Kronshtadt Group for the Russian Defense Ministry. The development contract worth around 2 billion rubles (some $35.3 million) was signed in 2011. According to available data, the aircraft weighs around 1.2 tons and can carry 300 kg of mission payload. The UAV will have loiter time of up to 24 hours.

Russian media reported in the spring of 2016 that the aircraft was being tested at the Gromov Flight Research Institute in Zhukovsky, outside Moscow. It appears that the UAV is currently undergoing flight tests, but the development effort is far from over.

The second, heavier MALE system, the Altair, has been under development at Kazan-based Simonov Test Design Bureau since 2011. The project costs about 1 billion rubles. In 2015, following the first flight, the company received a contract to carry out research and development. Series production is expected to follow eventually.

The Altair is a high-wing, twin-engined aircraft with a wing span of just under 30 m and a V-tail. The UAV will have loiter time of up to 48 hours and a range of up to 450 km. Its maximum payload capacity will be around 2 tons.

One of the roles proposed for the two MALE-class UAVs is monitoring of Russia's Arctic regions. To complement the work being carried out by the military and border service, the aircraft could be used for monitoring major facilities in the north of the country, and also to sup-

port navigation along the Northeast Passage. The Altair entered flight tests in July 2016, according to officials representing Russia's Republic of Tatarstan. Journalists took several pictures of the UAV at KAPO aerodrome in Kazan, including a photograph of the second flying prototype in an Arctic livery. Series production should begin in 2018.

High-altitude systems

One project to create a Russian high-altitude UAV is currently under development at the Central Aerohydrodynamic Institute (TsAGI) and Myasishchev Design Bureau.

No details are available, but the UAV is assumed to be similar in design to the US RQ-3, which itself is an alternative to a stealth high-altitude UAV.

Myasishchev was expected to give released design documentation by late 2015 and started building the first prototype in 2016. However, even if everything is going to plan, the project will talk a long time to implement.

Combat unmanned vehicles

Since 2012, Sukhoi has been developing the Okhotnik heavy reconnaissance/strike UAV. Mikhail Pogosyan, who headed the company at the start of the project, commented at the time that the Okhotnik was to become the first joint project between Sukhoi and MiG.

The UAV will have a take-off weight of about 20 tons, open sources suggest. It is expected to be an equivalent to the US-designed Northrop Grumman X-47 and Boeing X-45. Like its American counterparts, it will be tailless for reduced radar cross-section.

In 2014, Oleg Bochkarev, deputy chairman of the board of Russia's Military-Industrial Commission, said the first flight of the UAV was set for 2018.

However, if foreign experience developing such aircraft is anything to go by, even if the 2018 first flight goal is met, full implementation of the project is still far away.

In the past decade since the conflict between Russia and Georgia, the Russian Ministry of Defense has made significant progress in equipping the Armed Forces with UAVs. The ministry has come a long way, from single purchases to mass procurement of such aircraft. Currently the Russian armed forces possess more than 2,000 UAVs, and the military has gained significant experience in operating foreign unmanned systems. This has allowed for a better understanding of the UAVs' role in Russia's defense, and stimulated the development of domestic equivalents.

An-132D debuting in Le Bourget

The Ukrainian airframer Antonov is bringing its new An-132D transport turboprop aircraft to Paris Air Show 2017. The aircraft will be a part of both the static and aerial displays.

The aircraft is a joint development of Antonov, Saudi Arabia's Abdulaziz City for Science and Technology (KACST), and TAQNIA Aeronautics, a Saudi company. The assembly line is expected to be set up in Saudi Arabia.

The An-132D performed its maiden flight on April 30, 2017. It is a profoundly upgraded version of the 40-year-old An-32 transport. The improvements include new Honeywell avionics, Dowty R408 propellers, and an integrated air system supplied by Liebherr-Aerospace Toulouse.

The aircraft is re-engined with Pratt & Whitney Canada PW150As, which are also used on the Bombardier Q400 turboprop. Antonov says the new engines and propellers boost the aircraft's payload to 9.2 tons, compared to the An-32's 6.7 tons. The new aircraft's service ceiling is 9,000 meters, as distinct from the baseline's 8,100 meters.

Ukroboronprom, Antonov's parent company, says the aircraft's flight range with maximal payload and 45-minute fuel reserve will be almost doubled, from the baseline's 780 km to 1,400 km.

Antonov first announced plans to upgrade the An-32 in May 2015; back then the manufacturer was looking to launch production within two years of signing the contract with the Saudi partners. The Saudi assembly agreement was signed in early 2016. The partners are planning to build 80 An-132s, to be used in transport, intelligence, and electronic warfare roles. The Ukrainian manufacturer expects between 260 and 290 such aircraft to be sold globally by 2035. Potential operators are believed to come from Africa, Southeast Asia, the Middle East, and Latin America.

The An-132D is powered by Pratt & Whitney Canada PW150A engines

Antonov

Will upgraded fleets lead to price wars?

Russian airlines started to expand their fleets as the passenger demand grows

Tatiana Volodina

The average age of Russia's aircraft fleet has slipped from 11.2 years at the start of 2016 to 11.6 in 2017, largely as a consequence of rising leasing costs due to a weaker ruble, observes Andrey Kramarenko, a leading expert at the Institute for Transport Economics and Transport Policy Studies at Russia's Higher School of Economics. The average age trend is likely to continue in the coming years.

The average age of units received in 2016 – excluding the re-deliveries of the aircraft previously operated of the defunct Transaero – is 6.5 years. But, with the ex-Transaero aircraft included, the figure jumps to 8.5 years. This compares to just two years ago, when the average age was only 4.5 years and is a trend which suggests a favorable future at least for the Russian aircraft MRO industry.

The figures illustrate that the country's largest carrier Aeroflot remains the principal airline to receive new aircraft, while other Russian operators acquire brand new aircraft only occasionally, and the coming years will see no change to this trend. In the future, ex-Aeroflot airframes will likely be transferred to its subsidiaries and in particular to S7 Group, the country's second largest airline.

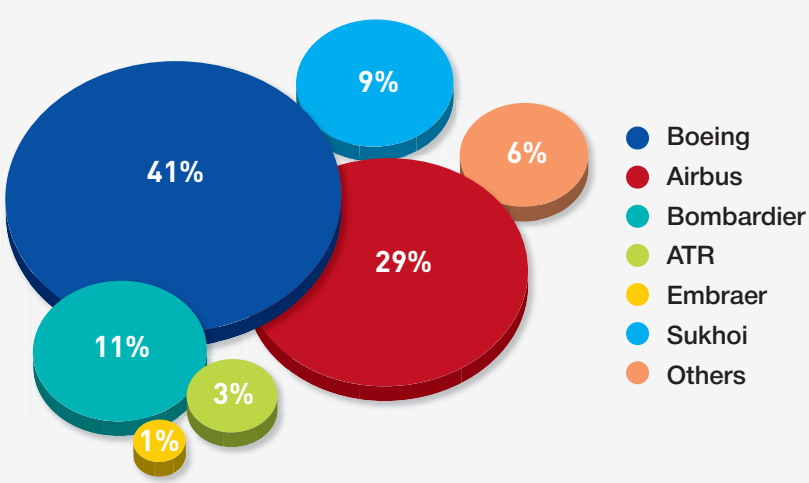
The fundamental structure of aircraft imports has remained largely unchanged for several years, with Airbus and Boeing contributing some 70% of the total airframes received. The remaining 30% consists of regional aircraft, with that sector experiencing a market share surge in demand for Russia's Sukhoi Civil Aircraft Company (SCAC, the manufacturer of SSJ 100 jet) over the past few years due mainly to governmental incentives.

Although it is expected there will be no significant changes in the deliveries pattern in the coming years, if the ruble continues to strengthen making the tourist flow cross over from domestic destinations to international, then the demand for widebodied aircraft will start growing. Russian carriers operated only 79 such aircraft last year, against the previous 58 and 90 in 2015 and 2014 respectively. Moreover, with the strengthening of the ruble, some airlines might consider newer aircraft operations.

Apart from the 79 widebodied aircraft, Russian airlines collectively operated 463 single-aisle and 348 regional aircraft at of the end of the previous year. Kramarenko reveals that Soviet-era aircraft carried only two per cent of the passengers, with approximately 90% carried by Airbus and Boeing aircraft, thus rendering the overall Soviet aircraft replacement potential almost complete.

He notes that, in 2016, the Russian market returned to the capacity growth numbers of middle pre-crisis levels, when airlines were collectively receiving about 100 aircraft per year. "Last year 80% of the new capacity was subject to mechanistic, uneconomic pricing strategies, a development that will likely mean that, in 2017, airlines will be forced to fill their fleets or leave aircraft on the ground with all the corresponding losses," he stresses. Speaking on Russian airlines' fleet growth rate forecasts for the 2017-2020 period, Kramarenko stresses that if Russian airlines adhere to the rational market policy, "we can expect

AIRCRAFT DELIVERIES TO RUSSIA IN 2010-2016, BY MANUFACTURER



Source: www.rusaviainsider.com

Fyodor Borisov / Transport-photo.com

The average age of aircraft received by Russian carriers in 2016 is 8.5 years

net fleet growth of about 30-40 airframes of any size per year".

However, despite the mass aircraft phase-out of the previous years – during which almost 20% of the country's total capacity was removed – operators have nevertheless ramped up their aircraft capacity too quickly. "This is an irrational capacity management stance whereby the carriers have started hastily buying new aircraft to meet the demand – instead of calmly making money steadily", Kramarenko warns. The worst-case scenario could lead to a fleet growth of 50-60 airframes (phase-out numbers not included).

Preliminary estimates show that, despite the end of the economic recession, Russia's GDP in 2017 will grow by 0-2%, with passenger consumer demand likely to grow by 2-3%, substantially less than the anticipated aircraft capacity growth. The previous years' scenario – with a 15% passenger traffic growth – "might only lead to price dumping".

The indicators are that the market situation will strongly reflect on Aeroflot remaining the biggest player and on its policy towards its daughter company Rossiya which, in 2016 together with Vim Airlines, introduced the most aircraft. "These airlines are most likely to be the main drivers for excess capacity generation next year and maybe in the coming years and this will result in price wars among the airlines and also between airlines and the rail services", Kramarenko adds. The largest Russian operator is readying for a new round of price wars, having willingly or unwillingly combined Rossiya with the defunct Transaero airlines.

Valery Okulov, Russia's Deputy Minister of Transport, has said that the average aircraft acquisition rate among Russian operators is about 60-70 airframes per year. With substitutions included, the average annual number of deliveries is estimated at 75-85 aircraft. Two thirds of these units are either in the 50-110- or 140-220-seat categories. Up to 2035, it is expected that Russian airlines will collectively receive up to 2000 airframes, of which up to 1300 will offer mainline services.

Meanwhile, according to the United Aircraft Corporation, the next surge in demand for wide-bodied aircraft is expected in seven to 10 years. According to Engineering Holding, Russia's largest MRO provider, the country's wide-bodied and long-haul fleet will almost double by 2020. The company also expects that carriers will phase out all Boeing 737 Classics over the next five years.

Russia's Ministry of Transportation notes that the world trend for the average aircraft lease period now stands at 7-12 years. This is because new-generation aircraft have longer key check intervals, a factor which will also influence developments in the Russian aviation market.

Sky arithmetic for Russian airports

Artyom Korenyako

Thus far, three Russian international airports have implemented Open Skies regimes, but their results have not been immediately impressive. Other airports are also considering the option – although the Russian authorities are urging operators to make thorough calculations first.

Vladivostok was the pioneer airport in instituting an Open Skies regime in Russia. Having been constructed five years ago, timed to coincide with the 2012 Asia-Pacific Economic Cooperation Summit, the new gateway was designed to process 1,360 passengers per hour, or 3.5 million a year. Bearing in mind the fact that Russia's Far-Eastern Federal District is the home for less than five per cent of the country's overall population, a more efficient mechanism was needed to stimulate a faster return on investment and Open Skies was seen as the solution to fill the comprehensively redesigned Vladivostok airport with passengers. The Russian Ministry of Transportation thus made an unprecedented decision in 2011: to allow foreign airlines to operate international flights to the city, including fifth-freedom services.

The Far East experience

Initially, Russia's Ministry of Transportation was eager to clear any foreign airline for flights to and from Vladivostok, i.e. within the established third- and fourth-freedoms of the air. The airport administration had anticipated that, in the event of a successful implementation of all stages of the Open Skies project (including issues related to Customs and immigration clearances), that passenger traffic at the hub would almost double. The airport projected that foreign airlines would launch new destinations to Taiwan, the Philippines, Indonesia, Malaysia, India, Australia, the USA and Canada, as well as increase numbers of frequencies and extend the geography of flights to China, Japan, South Korea, Singapore, Vietnam and Thailand.

But the plan failed. Compared to 2011, when Vladivostok airport registered 1.46 million passengers, in 2016 the hub served a modest 1.85 million, just 30% more. Unsurprisingly, in early 2014, Igor Lukishin, the general director of the airport, sounded less enthusiastic about the role and place of Open Skies in the hub's life. "Many people anticipated a surge in the airport's performances related to the Open Skies project, but I prefer to be more realistic about these things. The gateway is closely connected with the area. Passengers travel to the Primorsky Krai (Russia's Far East region – ed.) rather than to just the airport, be that for business or recreational purposes. What is important is that we see growth – and that it is steady," said Lukishin.

The airport official noted that the project has already provided the elimination of commercial restrictions for foreign airlines. However, apart from South Korea, Russian airlines have not been granted the same kind of privileges. "To change the situation, new air service agreements will be required as the existing ones limit the number of frequencies, slots, carriers, regular capacities and parties of charter flight operations. Apart from that, Russian air carriers are subject to domestic restrictions in terms of being cleared for international flights. So, at this moment, the current status of the Open Skies program does not allow for the full extent of its potential and makes the entire project less attractive for airlines," he added.

Five years after the Asia-Pacific Summit, the new terminal at Vladivostok is employing only half of its designed capacity

Leonid Faerberg / Transport-photo.com

The sky over the Black Sea

After the 2014 Winter Olympics an Open Skies regime was also introduced at the renovated airport of Sochi on the Russian Black Sea shore. A year before the event, the gateway's capacity was increased to 2,500 passengers per hour (mobilized to 3,800 during the Olympics). Last year the invigorated hub airport served a record-breaking 5.3 million passengers (29% up on 2015 and 68% up on 2014) and became Russia's fifth largest airport in terms of

passenger traffic. But this success can hardly be attributed to the Open Skies regime. Instead, the growing performances of the Sochi gateway have, to a certain extent, been determined by a combination of bans imposed on flights to popular foreign leisure destinations, Turkey and Egypt, along with other factors including ruble depreciation and overseas travel restrictions for employees of Russian security agencies. Nonetheless, the official response of Basel Aero's press office (the operating company of Sochi Airport) states that the positive effects of the Open Skies regime should not be underestimated.

The Open Skies regime was introduced at Sochi in autumn 2014 for three IATA seasons (winter 2014-2015, summer 2015 and winter 2015-2016) and, on May 31, 2016, the airport was informed about its prolongation until summer 2017. In 2015, flights within the program were performed by three carriers: Mahan Air (Iran), Turkish Airlines and SCAT. Last year four more – Qeshm Airlines and Meraj Airlines (both Iran), IsrAir (Israel) and SkyBus (Kazakhstan) – joined the list. Finally, in February this year German company Condor Airlines accomplished a program of charter flights to Sochi, a development made possible by Open Skies.

Basel Aero emphasizes that it works non-stop on enhancing the effectiveness of the Open Skies regime at Sochi. "However, the visa issue – the price and the lengthy application procedure – hinders the growth of incoming tourism," a statement points out. The introduction of a 72-hour visa-free regime would give the local air service market a timely impetus. Experts have already calculated that the introduction of a visa-free regime at some Russian airports would increase the number of incoming foreign passengers travelling by air by as much as 5-8 million annually.

The Baltic says hello

Khrabrovo Airport at Kaliningrad is the third Russian hub to have embraced an Open Skies regime. The Russian Transport Ministry granted the status to the country's westernmost gateway in December 2014. Initially, it was planned to be active for only three seasons – summer 2015, winter 2015-2016 and summer 2016 – but later, the regime was prolonged until the end of 2017.

In November last year, Alexander Kopytin, the airport's general director, revealed in an interview with the Interfax news agency that the Open Skies project had turned out to be groundbreaking. "We were given a great favor [with this extension] despite no airline having used it in the previous two years. That does not mean that the program has no future, quite the opposite. Although it can only be tied to foreign air carriers which will start to come back to us as we approach the 2018 FIFA World Cup", he said. Last year Kaliningrad Airport registered 1.57 million passengers, up 7.6 and 1.8 per cent compared to figures in 2014 and 2015 respectively. International traffic through Khrabrovo in 2016 dropped by 57% year-on-year in 2015 and totalled 62,400 people (or four per cent of the total passenger traffic).

Transport-photo.com

Pulkovo Airport is pinning its hopes on liberalization of air space regulations and the introduction of a visa-free regime

Contenders

In the past, several other Russian airports have shown interest in the Open Skies regime, including Emelyanovo (Krasnoyarsk) and Novy (Khabarovsk), both of which are in the process of actively upgrading their infrastructure. Evidently, the most active among them is Pulkovo Airport at St. Petersburg, which is rightly concerned about the growing market share influence of the Moscow air cluster, a factor which has lead to less investment in infrastructure at regional airports.

Pulkovo would certainly like to see air space and visa regulations liberalized. Considering the Open Skies regime has already been introduced at Vladivostok, Sochi and Kaliningrad, the St Petersburg airport administration thinks it would be fair to do the same there. But in 2015, Pulkovo was refused the special status – instead, the city was encouraged to use the resources of its base carrier Rossiya for the development of the airport.

In early 2017 Alexander Neradko, head of the Russian Air Transport Agency (Rosaviatsia), said that any decision about an Open Skies regime should be preceded by a thorough analysis of a potential outcome that it might produce over the air service market. "The thing is that the examples of Vladivostok, Sochi and Kaliningrad demonstrated no significant increase in passenger traffic or number of foreign airlines," he explained.

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IFC leases its first foreign-built aircraft

The first IFC-leased Q400 was delivered to Jambojet in May

IFC

Moscow-based lessor Ilyushin Finance Co. (IFC) has leased two Bombardier Q400 regional turboprops to Kenyan low-cost carrier (LCC) Jambojet, a subsidiary of Kenya Airways. This is the Russian company's first contract involving Western-built aircraft.

The deal was struck shortly after IFC firmed up one of its five Q400 options and added it to its single firm order for the type. The first aircraft was delivered to the customer in May.

"The agreement for these next-generation turboprops signifies a key development in IFC's international leasing business," Alexander Rubtsov, the lessor's general director, commented. "The demand for high-performance turboprops like the Q400 continues to grow, and we are happy to enter into this lease deal with Jambojet."

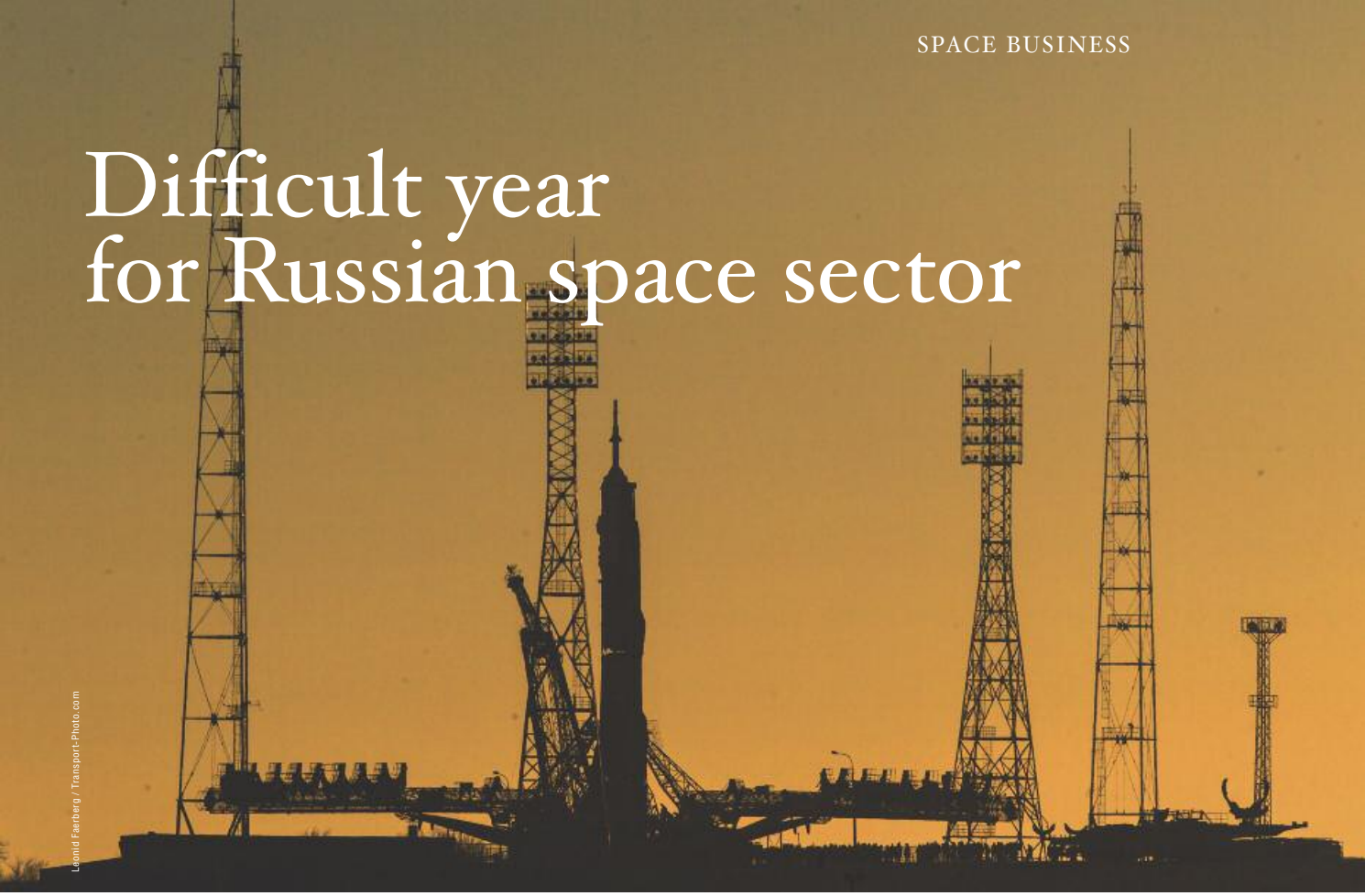
Willem Hondius, the Hambojet CEO, had this to say: "We are impressed with the level of professionalism that IFC exhibited throughout the process leading up to this first agreement."

The second airframe is planned to be delivered before the end of this year. The two aircraft will bring the total Bombardier Q-series fleet on the African continent up to 120 (this includes 70 Q400 airliners).

"We are proud of the Q400 aircraft's continued success in Africa," commented Jean-Paul Boutibou, Bombardier Commercial's vice-president for sales in the Middle East and Africa. "Jambojet's operations illustrate the capabilities and qualities of the Q400 aircraft that make it uniquely suitable for the region."

Jambojet was created less than two years ago, and operates flights from Kenya's capital city Nairobi to domestic destinations. The airline's fleet comprises two Q400s and two Boeing 737s.

Difficult year for Russian space sector



Leonid Faerberg / Transport-Photo.com

Igor Afanasyev, Dmitry Vorontsov

For the Russian space sector, 2016 proved to be one of the most difficult years in the past several decades. For the first time in 13 years, the country lost its leading position on the space launch market, falling behind China and the US. Of the 85 launches performed globally, Russia accounted only for 17. The country's share of the space launch market dropped from 33.72% to 22.09%, even with the two Soyuz launches from the Guiana Space Center figured in.

The drop in launch activity was caused by several factors. First, Russia had completed the creation of its navigation and communication satellite constellations, and their replenishment now only requires rare individual launches.

Second, the number of commercial launches had gone down noticeably: following a number of accidents involving Russian launch vehicles in the previous years, some customers switched to SpaceX and Arianespace as their service providers.

Third, a number of launches had been postponed due to the delayed adoption of the federal space program for 2016-2025 (FSP 2025) and also because of cuts to the space budget. In fact, the entire national space launch program for the second half of 2016 had degraded to five service missions to the International Space Station (ISS).

Serious problems involving the quality of Russian space equipment also took their toll. A new analysis of the results of random tests on second-stage engines for the Proton-M launch vehicle revealed the use of an inferior soldering alloy. As a result, Roscosmos State Corporation decided to recall 71 engines of the rocket's second and third stages for inspections and repairs. Proton launches were effectively suspended until the summer of 2017.

Despite the downbeat end of the year, 2016 in general was not that bad for the industry, particularly its beginning. Four Russian spacecraft were launched into orbit: the Soyuz TMA-20M, the Soyuz MS, the Soyuz MS-02 and the Soyuz MS-03. An important achievement was the beginning of operations of the Soyuz MS, the latest modification of this manned spacecraft series with an all-digital control system.

Another milestone came in the form of the first launch from Russia's new Vostochny Cosmodrome. On April 28, 2016 a Soyuz-2.1a successfully inserted three satellites into orbit: the Lomonosov scientific vehicle, the Aist-2D Earth remote sensing probe, and the SamSat-2018 student nanosatellite.

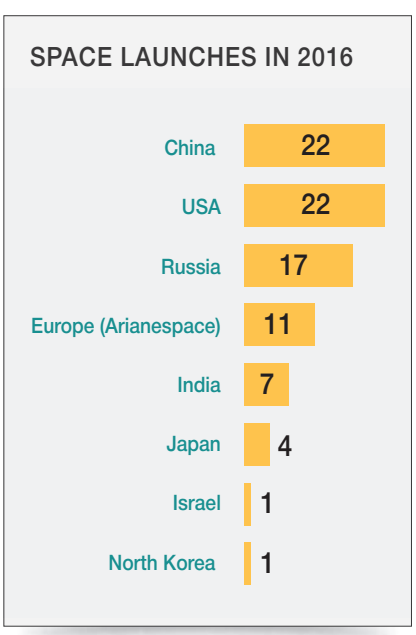
From the technical standpoint, this launch became an important breakthrough in the national satellite construction sector: the orbiting of the Aist-2D gave Russia its first small-sized remote-sensing probe with high-resolution equipment (1.5 to 2 m in the panchromatic range). This miniaturized satellite weighs not more than 530 kg; to compare, relatively recently the only Russian space vehicle with com-

parable operational parameters would weigh in at around six tons!

The operation of Vostochny will continue in 2017: the cosmodrome is expected to be used for two launches this year, and the annual launch rate is set to grow gradually.

The Resurs P No 3 optoelectronic Earth observation satellite was orbited on March 13. Together with its two siblings, which had been launched previously, it is part of a constellation of civil observation satellites capable of taking photographs of super-high spatial resolution (better than 1 m). On March 24, the Bars-M No 2 military mapping satellite was orbited. This, in combination with the Persona, Kanopus-V, and Aist-2D satellites already in orbit, makes the Russian Earth observation constellation one of the most powerful in the world.

The Russian-EU ExoMars 2016 project got off to a successful start: on March 14, a Proton-M vehicle with a Briz-M booster put a probe consisting of two main modules (the Trace Gas Orbiter, TGO, and the Entry, Descent and Landing Demonstrator Module, EDM) onto a trajectory to Mars. The TGO houses four primary scientific instruments, two of which, created with active participation of the Russian Space Research Institute, and are intended for studying the gas composition of the Martian atmosphere. Equal participation in the ExoMars project gives Russia the opportunity to conduct international-level interplanetary research.



Russian engine builders managed to expand their presence on the global markets: deliveries of 390-ton-thrust RD-180 engines for US Atlas V launch vehicles continued, and on October 10, two new NPO Energomash RD-181 engines, with 196 tons of thrust each, blasted off as part of an Antares 230 rocket. The design documentation was released in 2014, and the first bench test followed in May 2015, after which four RD-181s were shipped to the customer. In March 2016, Orbital ATK, Antares 230 manufacturer, decided to firm up its option first for eight, and then for 14 such engines, to be delivered in 2017-18.

In another positive development fire tests began on the 40-ton RD162SD demonstrator (also known as the RD0162D2A) developed by Voronezh-based Chemical Automatics Design Bureau. The engine runs on liquid oxygen and methane. The bench prototype is a scaled-down version of the RD0162 reusable engine with over 200 t thrust.

In a milestone development for the Russian rocket and space industry, Russia adopted the federal space program through 2025. Despite the space budget having been cut from the original 2.8 trillion rubles ($49 billion) to 1.4 trillion, the program still lists the key applied and scientific research projects. The document calls for the continuation of work on the ISS project and for further expanding the station's Russian segment. Unfortunately, some of the projects related to unmanned flights to the Moon and Mars were excluded from the program, as was the creation of a superheavy launch vehicle for Lunar flights. Instead, a version of the Angara-A5V will be developed, possibly to be used in the initial phase of the new Lunar program.

Another remarkable 2016 event was the signing of a government contract worth around 58 billion rubles between Roscosmos and Energia Corporation for the development and testing of the Federation PPMS. The flight tests will be implemented in three stages: an unmanned flight to the Earth orbit in 2021; an unmanned flight and docking to the ISS in 2023; and a manned flight and docking to the ISS, also in 2023.

Russian rocket builders announced new projects last year, including for a medium-class launch vehicle to be created as part of Project Feniks. The new rocket is expected to be able to insert 16 to 17 tons of payload into low-Earth orbit and up to 5 t into geostationary transfer orbit. Its first stage could be equipped either with a single 740-ton RD-171M engine or with two RD-180s. The vehicle is to be jointly developed by Progress Rocket Space Center (the lead developer), Khrunichev Center, Makeyev Rocket Design Bureau, and Energia Corporation.

Feniks is to enter flight tests by 2022. It is intended for the revived Sea Launch project (it was bought by Russia's S7 Group) and also as the first-stage module for the future superheavy launch vehicle intended for Lunar and Martian missions.

Khrunichev presented projects to create the light and medium versions of the Proton-M launch vehicle. The decision was made to go with the medium variant for the time being, which will be able to insert around 5 t of payload into geotransfer orbit. Seeing as lower-weight (between 3 and 5 tons) telecom satellites are now entering the market, the rocket will enable launch operator International Launch Services to retain and even expand its share of the commercial launch market.

Samara-based Progress Rocket and Space Center announced a project to develop the Soyuz-2LK light vehicle, which is to be less expensive than the current Soyuz-2 thanks to the absence of a third stage, which will be replaced with the Fregat booster. The rocket will be able to insert significantly heavier satellites into sun-synchronous orbit than the Angara-1.2 and the Soyuz-2.1v: 2 and 3.85 t, depending on the launch site location and the orbit parameters.

New strategy for Russia's space industry

Igor Afanasyev, Dmitry Vorontsov

The core of Russia's future manned spaceflight program will be participation in the ISS program

NASA

In February, the steering committee of Russia's Roscosmos State Corporation approved the new development strategy through 2025 and development roadmap through 2030. The new strategy is to ensure the industry's progressive development in the country's interests. This is to be achieved through mobilizing internal reserves, generating new ideas, and availing of the opportunities provided by the international and domestic markets.

Roscosmos General Director Igor Komarov commented that the Russian space industry's development should focus on commercialization of space services, boosting the efficiency of the International Space Station (ISS) operations, and improving the quality of launch vehicles and space vehicles.

The strategy calls for Roscosmos' revenues to grow 1.85 times by 2030 as compared to the 2017 level. The share of the corporation's revenue on the global available market is projected to grow from the current 4.8% to 9.5%. The share of revenues generated by extra-budgetary projects is to increase from 25% in 2017 to 50% by 2030.

Russia is to retain a 25% share of the space launch market, generating $2.8 billion in revenues annually. The strategy particularly stresses the need for increasing the reliability of launch vehicles and the quality of spacecraft. By 2030, the reliability of launches is to have grown from the current 93% to 99%; the service life of low-orbit satellites is to reach 10 years, and that of geostationary spacecraft, 15 years.

Roscosmos is planning to increase its presence in a number of new market segments: to 4.0% in the Earth remote sensing segment, which translates to $2.9 billion in revenues; to 20% in the manufacture of automated satellites ($2.2 billion); and to 26.6% in mobile satellite communications ($1.8 billion). Russia's share in the ISS project, and in providing crew rotation services, is to grow from 20 to 23% ($2.2 billion). The greatest growth is expected in the navigation services and equipment sector, from the current 0.1% to 7.0% ($9.6 billion).

Advanced technologies are to be developed in several segments. In the future, automated devices are to be used for servicing satellites in orbit; there are plans for creating constellations of small-sized spacecraft with the functionality of large satellites; and the industry is to develop competencies in additive technologies with the use of materials returned from space. In the manned spaceflight segment, the document calls for developing crew protection methods against prolonged exposure to radiation; for creating life support and autonomous medical and biological systems that could operate for prolonged periods of time in increased radiation environments; for the development of robotized devices incorporating AI elements; and for advances in 3D bioprinting. The document also calls for testing nuclear energy technologies in space as a step toward long-distance interplanetary flights.

The priority space activity segments are automated communications satellites, Earth remote sensing probes, navigation spacecraft, and scientific research. Only after these does the strategy mention manned spaceflight and launch vehicles.

By the year 2020, the Russian orbital constellation will comprise 31 communications satellites, including high-energy vehicles with broadband access and back-to-back relay. Their number will have grown to 43 by 2025 and to 46 by 2030, including mobile satellite communications vehicles serving mass consumers and new-generation repeater satellites. A throughput capacity growth of nearly 20 times is expected: from 3.3 Gigabit to 60 Gigabit per day.

The Earth remote sensing constellation is to comprise 17 vehicles by 2020, including weather satellites in highly elliptical orbits for Arctic observations and for all-weather surveillance with the use

Russia's heavy Proton vehicles will be phased out in late 2025

ESA–Stephane Corvaja

of S-band radars. The figure is to reach 22 by 2025, and the constellation's functions are to be expanded to include full-scale weather support, highly detailed surveillance in the visible band, and all-weather surveillance in the S and X radar bands. By 2030, the constellation's functionality is to further expand to include emergency surveillance in visible and infrared bands. Spatial resolution is to be increased from 0.9 to 0.4 m for the visible band and from 200 to 30 m for infrared.

The GLONASS constellation is to expand from 24 to 30 satellites, and the positioning accuracy is to be boosted from the current 2.7 m to 0.6 m globally and 0.1 m for Russia. The plan calls for increasing the signal availability in adverse conditions from 49% globally and 78% for Russia to 65% and 92%, respectively. New Glonass-K2 and Glonass-VKK satellites are to enter service by 2025, and are to completely replace the vehicles of the previous generations by 2030.

The strategy also calls for launching the Spektr-UF and Spektr-RG space observatories, which are to join the Spektr-R lab that has been in orbit since 2011. The lunar program will involve the launching of a Luna-Glob orbiter, two Luna-Resurs landers, and one Luna-Grunt sample return vehicle. The Arka and Rezonans-MKO small-sized satellites will be launched to conduct scientific research of the Sun and of the solar-terrestrial relationship. Russia will also continue to participate in the ExoMars interplanetary mission.

The core of the country's manned spaceflight program will be its participation in the ISS program. In 2020-25, the Russian ISS segment is to support scientific research and experiments (30% of the total workload), testing of critical technologies (25%), and other experiments (45%). The latter will include growing large superpure semiconductor crystals and a number of commercial experiments sponsored by government and commercial organizations.

The key objective of the manned part of the strategy will be to minimize government spending at the expense of commercial profits, for which purpose services are planned to be provided to partner nations in the form of delivering their astronauts and freights to the ISS. Boosting the efficiency of the Russian segment is to be achieved both by way of increasing the effectiveness of its use and by way of cutting the station servicing costs. The share of important applied experiments is to be increased, and the number of program participants with "new ideas" expanded.

The document calls for introducing private-public partnership practices to the commercial operation of the ISS and the transportation system, e.g. by establishing a dedicated operator.

A Russian scientific module will be sent to the ISS by the end of 2018, followed by another two before 2020. By that time, the future of Russia's participation in the program needs to have been decided. The ISS program has been approved through 2024; should international collaboration cease beyond that date, the possibility cannot be ruled out that Russia will undock its national segment and continue to operate it autonomously.

Russia will continue to use the Soyuz-2 series of light and medium launch vehicles. New launch vehicle projects include a medium rocket under development as part of the Project Feniks effort to create a superheavy rocket. Three versions are planned: one to be launched from the Russo-Kazakh Baiterek launch pad at Baikonur Cosmodrome (with the first launch set for 2021), another one for Sea Launch (the first launch is planned for 2022), and the third one intended for Russia's new Vostochny Cosmodrome. In the latter case, the Feniks is set to lift off from the site for superheavy rockets, which is expected to have been built by 2034. Also at Vostochny, flight tests of a superlight rocket are expected to begin in 2028, and tests of a light launch vehicle with a reusable first stage from 2031. Launches of Soyuz-2 medium rockets will continue from Baikonur and Plesetsk. Heavy Proton vehicles will be phased out in late 2025.

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