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• AEROSPACE INDUSTRY
  Russia keeps its ambition in commercial aircraft ....................2
  VSMPO and Boeing expand titanium partnership in Russia ..........6
  Aerosila showcases hi-tech ......................................7
  Aeropribor-Voskhod goes innovative ..............................8
  PD-14 engine for Russian MC-21 receives certification ..........9

• DEFENSE
  TMC demonstrates precision-guided weapons .......................10
  Su-57 to enter service in 2019 .................................10
  Russia becomes largest warplane manufacturer ..................12
  Su-30SM to get new engines ....................................12

• AIR TRANSPORT
  China-friendly Russia and Russia-friendly China? .................14

• BUSINESS AVIATION
  Russian business aviation enjoys upward cycle ...................19

• SPACE BUSINESS
  Uncertain future of International Space Station ...............22

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Russia keeps its ambition in commercial aircraft

Maxim Pyadushkin

Russia’s only planemaker United Aircraft Corporation (UAC) became the world’s largest manufacturer of combat aircraft, but it also plans to increase its share in the commercial segment. The Russian manufacturer’s ambition is to raise its current 1.8 per cent share of the global market to 4.5 per cent by 2035. This may become achievable only after the launch of serial production and deliveries of the corporation’s new civil products: the MC-21 narrow-body and the CR929, the wide-body program which is being developed jointly with China’s COMAC.

In 2017, the Russian manufacturer delivered 32 commercial aircraft to customers. Of this number, 30 were Sukhoi Superjet 100 (SSJ100) regional jets. According to UAC’s own estimates, this places it as the world’s sixth largest producer of civil aircraft (namely, jet and turboprop airliners with a seating capacity above 20 seats).

The situation can change after UAC fell under control of the industrial giant Rostec during another round of consolidation of the country’s aircraft industry. Russian president Vladimir Putin issued a bill in October allowing to transfer the government share of 92.31% to Rostec.

Rostec is the state-owned corporation governed by Putin’s close friend Sergey Chemezov. It was founded in 2007 on the basis of Rosoboronexport arms trade agency and gradually take control over the government assets in the defense and automotive industries.

It has already become the largest UAC supplier, providing the manufacturer with 70% of aircraft components and subsystems, including engines, avionics, hydraulics and composites. Rostec’s most important asset is United Engine Corporation that supplies powerplants for UAC and the country’s rotorcraft manufacturer – Russian Helicopters also owned by Rostec. After the merge, Rostec’s aviation cluster will have an estimated turnover in excess of one billion rubles ($15 billion).

But the manufacturer’s efficiency is nevertheless will be affected by external political influences which will not only affect the prospects for further international cooperation but also the future marketing of Russian-built aircraft in the global arena.

Superjet 100

The SSJ100 remains UAC’s only revenue-generating aircraft program, other projects are in development. In 2017 the number of deliveries reached 30, partly as a result of effective state support mechanisms, with all domestic deliveries financed via state-run lessors.

As of September 2018, there were some 132 SSJ100s in operation, mostly with Russian airlines, although some are with commercial and governmental operators in Europe, Mexico, Thailand and Kazakhstan. The program received a serious boost on the same month when its largest customer Russia’s largest airline Aeroflot placed a new order for 100 aircraft of the type. The deliveries are planned for 2019-2026. The deal will provide UAC with a guaranteed capacity load to keep steady, average rate of between 25 and 30 deliveries a year now, achieved in recent years.

However, threatened by the existence of new-generation, western-built competitors, such as the Embraer E-Jet E-2 and the Airbus A220, as well as by the might of the Airbus/Boeing duopoly’s expansion into this market segment too, the SSJ100’s future now hangs on the
manufacturer’s ability to significantly improve the aircraft’s performance.

In response to this competitive challenge, SCAC is working in two marked directions. The first is to expand the operational capabilities of the existing platform to match customer demands. One such effort resulted in a modification – dubbed the SSJ100B-100 – which features more powerful PowerJet SaM146-1S18 engines, improved software for avionics and enhanced high-lift devices control systems. The testing of aircraft equipped with blended winglets (Sabrelets), which will be offered for both new aircraft and as a retrofit option, is also underway.

The second path to a more sustainable future is the positive targeting of politically-sensitive clientele, such as governmental operators and countries under western sanctions. This requires a major reduction of western-produced aircraft parts and components by replacing them with Russian-made alternatives, which is the aim of the SSJ100R, the special ‘Russianised’ version.

However, while these efforts may help the program to remain airborne, more radical modifications are needed to successfully compete with the arrival of new models envisioned by Embraer, Bombardier and, potentially, Mitsubishi. Typically, the recent change in SCAC’s top-management has redirected the likely flight path of Superjet’s future away from the stretched version to the shortened, 75-seat variant.

Notably, a decade ago, the short version was considered as the base option at the program’s launch. In reality, the desired outcome is de facto a virtually new model, with new engines and possibly a composite wing. Russia’s second largest carrier – S7 Airlines – has already voiced a cautious interest in the aircraft, which may enter the market in the 2022-2023 timeframe. A letter of intent, inked by S7 and SCAC in April, could mature into a firm order before the end of this year, for 50 of the version dubbed SSJ75, with an option for up to 25 more.

Work on an improvement of the company’s after-sales support is also underway.

**MC-21**

Developed by Irkut Corporation, the MC-21 narrow-body is destined in the short term to become the flagship product of the Russian civil airspace industry. It made its maiden flight in May 2017 and, one year later, the second flight prototype joined the testing.

Neither UAC, nor Irkut have been particularly diligent in their reporting on the test results. In July 2018 the manufacturer announced that the second flying prototype had been ferried to Zhukovsky to join the certification testing program, and that three more aircraft were in the process of being assembled at the Irkutsk Aviation Plant. By July, the second flight prototype had ac-
cumulated some 14 hours of flight time, during which it reached an altitude of 12,000 meters and a top speed of 0.8M (TAS 850 km/h). Further testing is to be conducted at the premises of the freshly upgraded Flight Testing Facility (FTF) of Yakovlev Design Bureau, which recently acquired a new hangar and a new hub for the collection, processing and analysis of flight data.

The certification of the aircraft’s base version, the MC-21-300 powered by Pratt & Whitney PW1400G engines, is still scheduled to complete before the end of 2019, with the first deliveries slated for 2020. The backlog currently includes 175 firm orders, mainly from state-run leasing companies. There are three airlines currently claiming the title of launch operator: national carrier Aeroflot, UAC-associate Red Wings (owned by Ilyushin Finance Company) and the private Irkutsk-based IrAero (the city where the MC-21 is to be assembled).

Aeroflot is the largest customer, with a commitment for 12-years operational leases for 50 aircraft via Rostec’s subsidiary Avia Capital Services. The first 25 deliveries will each be powered by Pratt & Whitney engines but, from the 26th aircraft onwards, the Russian PD-14 turbofan may be an option.

By 2020, when the MC-21 is expected to be available for revenue operations, it will enter a highly competitive marketplace, as the demand for next-generation narrow-bodies may by then be significantly satisfied by the re-engined Airbus A320neo family and the Boeing 737 MAX. Both types have already entered service in 2016 and 2017 and, as iterations of tried and tested existing designs, by 2020 will have probably overcome any teething problems.

**Russo-Chinese CR929**

In the wide-body segment, UAC’s new product, the CR929, is being developed jointly with China’s COMAC. For the Russian industry, this project is an opportunity to retain the competence, share the development costs and gain access to the growing Chinese market for larger aircraft. For the Chinese partner, it is a chance to benefit from exposure to Russia’s expertise in aircraft design whilst, at the same time, building experience in developing such wide-body programs.

In the one year that has passed since the China-Russia Commercial Aircraft International Corporation (CRAIC) joint venture was established in Shanghai in May 2017, the CR929 program has reached several milestones. In December last year it passed the project’s Gate 2 stage, which defined the overall concept for the new aircraft family, which embraces three variants — the base CR929-600 platform, with 280 seats in a three-class configuration; the shortened iteration CR929-500 for 230 passengers; and the stretched version CR929-700, with seating capacity for 320 passengers. The general layout, including the shape and span of the wings, the length of the fuselage, the parameters of the nose and tail sections, and the location of the engines, landing gear and doors were all finalized in June 2018. According to these parameters, the CR929 should be somewhat more spacious than the rival Airbus A330-300 and its advanced A330-900neo versions.

This perceived advantage is indicative of the project’s primary focus on the Chinese market, which currently favors the A330-300 as its main ‘workhorse.’ The CR929 program is now at the Gate 3 stage, a definition phase which is expected to complete by mid-2019.

CRAIC has also been sending requests for tenders for the supply of engines and engine nacelles, as well as for landing gear mechanisms. Although the planemaker has not disclosed who the potential suppliers are, it has admitted that it has received bids from seven engine manufacturers. General Electric and Rolls-Royce both have engines in the right thrust range to power the new aircraft, and may be on the list. Another
option that has been brought to the table is the Russian-made PD-35 engine, which is currently under development.

The program’s production schedule was first announced in June 2018, with assembly of the first prototype planned to begin in 2021, the maiden flight slated for 2023 and entry into service in 2025.

The semi-civil projects
United Aircraft Corporation has two more commercial projects in its portfolio — the Ilyushin IL-114-300 regional turboprop and the IL-96 wide-body airliner. Although there are currently no orders for these aircraft from commercial operators, they are nevertheless being artificially supported by the state in order to preserve the Russian industry’s competences and capabilities in their respective segments.

In May 2016, the Russian government made a decision to upgrade and re-launch serial production of the Ilyushin IL-114-300 regional turboprop twin aircraft. Initially produced in Uzbekistan by the Tashkent Aviation Production Plant, the program is now undergoing modernization and relocation to Russia, following the trials of the similarly-fated IL-76 transport aircraft. Ilyushin, the type’s design company indicates that serial production of the aircraft may not restart before 2021. In the meantime it promises a more powerful engine, new avionics suit and a re-designed passenger cabin. The backlog currently includes a single letter of intent (LOI) for 50 units from GTLK signed in 2017.

A similar pattern is emerging with the IL-96-400M, the new passenger derivative of the existing four-engined wide-body freighter. The production of the type is being sustained by orders from governmental customers with the purpose of preserving the competences of wide-body aircraft design and production capabilities of the Voronezh Aviation Production Plant (VASO), an UAC subsidiary.

The modernization effort, which was launched in 2017, predicates a production output of an annual rate of two-to-three aircraft up to 2025, the year when the CR929 is expected to enter commercial operations. The list of potential customers includes Rossiya Special Flight Squadron, which is responsible for carrying the country’s high-ranking officials, the Russian Defence Ministry and other government bodies, a situation that qualifies both the IL-114 and the IL-96 as ‘semi-civil’ projects.
Aerospace Industry

VSMPO and Boeing expand titanium partnership in Russia

Maxim Pyadushkin

Boeing has quietly doubled its titanium parts production capacities in Russia despite growing political tensions between the two countries. The company’s top officials – CEO Dennis Muilenburg and the president of Boeing International Marc Allen travelled to Sverdlovsk region of Russia on September 19 to open a new production facility for Ural Boeing Manufacturing, a 50/50 joint venture with the local titanium manufacturer VSMPO-Avisma.

Boeing’s strategic partnership with VSMPO-Avisma dates back to 1997, and their UBM joint venture was legally formed in 2009 at Verkhnaya Salda, a home town of VSMPO-Avisma on the eastern slopes of the Ural Mountains. It makes initial machining of titanium forgings for Boeing 737, 777 and 787 programs.

Commenting on the opening of the second site, Mikhail Voevodin, head of VSMPO-Avisma, emphasized that the event is one in a series of consistent steps which will extend the co-operation between the two companies, develop new technologies, build additional capacities and boost production outputs.

The original memorandum to double UBM’s capacities was signed at the Dubai Airshow 2013 with a view to launching the new site by 2016, a completion schedule which was later postponed to 2018. The 20,000-square m site is highly automated and capable of final, as well as rough, machining of components.

It became a part of Titanium Valley special economic zone and will process titanium forgings for 787 as well as for the new aircraft like 737MAX and 777X, reported Sverdlovsk region governor Evgeny Kuivashev, the only Russian top government official who attended the inaugurating ceremony. The total investment accounted for 5.5 billion rubles (about $83 million).

Russian titanium plays a vital role for Boeing business. VSMPO is one of the largest titanium manufacturers in the world. It currently holds about 30% of titanium supplies for global aerospace industry. The company reported it had delivered 15 tons of this metal in the first half of 2018, by 5.9 percent more than a year ago. Its revenue grew by 5.7 percent to 38.2 billion rubles (around $584 million).

According to the Russian Ministry of Industry and Trade, VSMPO annual supplies to the US market total $560 million, including about $350 million of titanium shipped to Boeing only.

Besides the US planemaker the Russian joint venture supplies parts for third parties, like General Electric and Rolls-Royce, as well as manufacturers of landing gear. The Russian manufacturer also sell titanium to Airbus and Embraer.

But the April sanctions imposed by the USA on Russia have prompted the Russian government to propose restrictions on such co-operation in the aerospace industry. However, VSMPO-Avisma warned about the imminent negative effects of such measures and, subsequently, Denis Manturov, Russia’s Minister for Industry and Trade, announced that the response to the sanctions should not affect VSMPO-Avisma and other residents of the Titanium Valley.

The Russian company is also a long-standing partner of the Chinese aerospace industry. Since 2004, it has been supplying China Aviation Supplies Imp. & Exp. Corporation (CASC) with titanium billets used in the manufacture of die-forgings for Airbus programs.

VSMPO-AVISMA acts as a supplier for China’s flagship commercial aviation program of the C919 medium-haul jetliner. Under the agreement with the aircraft designer, Commercial Aircraft Corporation of China (COMAC), it will be supplying 12 different die-forging types through to 2021.

Boeing and Russian officials are opening new facility at Ural Boeing Manufacturing
Two leading Russian companies - SPE Aerosila and High Technologies are jointly showcasing their capabilities as part of Russia’s exposition at Airshow China 2018. At their stand (H5C2-2), the show visitors can view equipment both for existing aircraft types and for perspective models developed jointly by Russia and China.

Aerosila is one of the world’s most experienced companies in developing air propellers for aircraft and air-cushion vessels, and small-size gas turbine engines. High Technologies is a leader in mass production of aviation and rocket components. Their production has the unit operational parameters at the world’s top level.

Showcased at Zhuhai, auxiliary power unit APU ТА14 is one of the models in the production range of APUs based on ТA14/14-130 gas turbine engine. More than ten modifications of this engine power different fixed-wing and rotor aircraft, including Yak-130 jet trainer, Su-34/35 combat aircraft, Ka-31, Ka-52 and Mi-8/17 helicopters. Most Russian-made aircraft are equipped with APU produced by the company, and air propellers with 0.9 efficiency are the standard for turboprop aviation. The company’s production has high export potential, as its APUs are fitted on export versions of Yak-130 and Su-35.

Basic APUs manufactured by the company are capable of fully supplying all on-board equipment with electric power on all existing and developed aircraft, including joint Sino-Russian projects: AHL heavy helicopter and CR929 widebody airliner. For the future heavy helicopter the company proposes TA18-100 APU. Modifications of this APU are offered for the upgraded Mi-26T2 giant helicopter and Sukhoi Superjet 100 regional jet. The company revealed that its Chinese partner has already agreed to modify this APU to reduce its weight to meet the AHL project specifications.

The Russian developer has submitted its proposal for a more powerful TA18-200 APU for CR929. The selection of suppliers for this program is expected to complete before the end of 2019.

The APU cores produced by Aerosila can also serve as base for on-board power units and electric powerplants for future more electric aircraft (MEA) and other electric vehicles. Designed by the company, co-axial propfan rotors with unrivalled performance have raised interest with aircraft developers for replacement of conventional propellers, as this will allow to increase their altitude and speed parameters, and operational efficiency.

“We cooperate with our customers, both in terms of supplying serially produced items and offer customization op-

Aerosila is bidding to supply its TA18-200 APU for Russo-Chinese CR929 widebody airliner.
AEROSPACE INDUSTRY

Aeropribor-Voskhod goes innovative

At the Airshow China 2018, Russian designer of control and automation media for aviation industry, Aeropribor-Voskhod is demonstrating multifunctional aerometric systems and flight instruments for commercial and military aviation. But the company is already making plans to expand its capabilities to provide innovative solutions for satellite navigation, rocket and space equipment and high-precision weapons.

One of the company’s latest developments, general helicopter equipment management SUOVO system is currently being successfully tested on flight-test prototypes of Kamov Ka-62, Russia’s new medium-class utility helicopter. In essence, this system is “the heart” of electrical power supply for the helicopter’s entire on-board electronic equipment, as it is responsible for distribution of electrical power to all on-board consumers and for managing more than 30 of the helicopter’s systems.

Another important development of Aeropribor-Voskhod, multifunctional flight data metering equipment have been undergoing testing on-board of the perspective MC-21 narrow-body passenger airliner, the flagship program of Russia’s aerospace industry, since 2017. This equipment is used for measuring, calculating and indicating data on aircraft’s altitude, speed, angles of attack and yaw, OAT and braking temperature, and feeding this data to other aircraft systems. During flight testing of MC-21 no malfunctions have been registered and no negative comments have been made about the system’s functionality, Aeropribor-Voskhod reports.

One of the company’s innovative designs is a spherical polyhedron air pressure probe-converter, developed jointly with Central Aerohydrodynamic Institute (TsAGI). This equipment was first showcased this summer at the international Army-2018 forum in Kubinka near Moscow.

The distinctive geometry of the spherical instrument and its holding device differs from conventional probes by usage of polyhedrons instead of smooth bodies. It also features simplified calculation algorithms and most importantly, its size and weight are significantly reduced, as well as inertia moments of the parts, which come in contact with the wind stream. This allows for more flexibility in terms of location of the system’s modules. Designers suggest placing the new equipment on the front part of the aircraft fuselage from both the right and left side, symmetrically.

Preliminary wind-tunnel testing at TsAGI have confirmed the best metering performance of the new probes, Aeropribor-Voskhod reports. This paves way to its implementation as part of flight parameter measuring systems on any type of rotorcraft, including perspective high-speed helicopters.

“For over 70 years our company has been producing equipment for aircraft, both civil and military,” says the general director of Aeropribor-Voskhod Oleg Guliaev. “Presently our company specializes in design and serial production of multifunctional radio electronic systems for all modern aircraft, including those involved in [Russian military] missions in Syria. It also creates equipment for perspective aviation and space craft, as well as for unmanned flying vehicles.”

Multifunctional aerometric systems and instruments for military aviation, designed by the Russian company are used on MiG-29K, Su-30MKI, Su-35S, Su-57, MiG-35 fighters. Smart sensors, flight instruments and systems for military transporters are installed on Il-76MD-90A and Be-200. Besides the Ka-62 management system, the company develops air parameter measuring systems for Ka-52 combat helicopter and its ship-based variant Ka-52K.

Aeropribor-Voskhod was founded in 1944. Since 2012 it has been part of Radio Electronic Technologies Concern (part of Rostec). The company has huge experience and potential for the future, there are new opportunities ahead, as it is heading towards innovation.

The nearest plans include expanding its capability list and profile. The priority directions are design and production of high-precision satellite navigation systems, development of systems and aids of navigation for air forces and commercial aviation, design of equipment for rocket and space, and for high-precision weapons.
PD-14 engine for Russian MC-21 receives certification

The Russian PD-14 turbofan engine that has been designed to power the all-new Russian MC-21 narrow-body jetliner has been granted a type certificate by the country’s federal air transport agency, a decision that signifies that the powerplant is ready for operation, reports the Russian Ministry of Industry and Trade. Validation of the certificate by the European Aviation Safety Agency (EASA) is scheduled for 2019.

Reportedly, three PD-14s will be delivered to MC-21 manufacturer the Irkut Corporation by the end of 2018 for flight tests on one of the prototypes. The first PD-14-powered MC-21 will be demonstrated in Q2 2019 and, as previously reported. The MC-21 with PD-14s is due to receive certification in 2021.

The new Russian engine was designed and developed in conjunction with the national 2013-2025 Aviation Industry Development Program, a project initiated by the United Engine Corporation (UEC).

The engine secured its certification shortly after the formal approval of its FADEC digital control system — one that boasts extreme reliability, UEC officials say. The engine is capable of working without the need for a hydromechanical protection so that all engine modes, from start-up to stop, are governed solely by electronics. The PD-14’s FADEC consists only of advanced Russian hardware components.

The powerplant has also recently completed climate tests under ‘classic’ icing conditions. On top of that, UEC has promised to extend the lifetime of engine components six-fold, by utilising a new heat-resistant granular alloy.

The MC-21 will also offer Pratt & Whitney PW1400Gs as an option. This version of the aircraft will be the first to win certification. It is believed that its type certificate will be issued by the end of next year.

Russian national flag carrier Aeroflot is planning to receive up to 24 PD-14-powered MC-21s. At the same time, smaller carriers such as Irkutsk-based IrAero and Moscow-based Red Wings, have also shown interest in this version of the all-new Russian airliner.
Russia’s Tactical Missiles Corporation (TMC) is showcasing its precision-guided weapons within a combined exposition at the Airshow China 2018. The corporation unites more than 30 companies focusing on design and production of highly sophisticated missilery, space-rocket and underwater technologies. Its booth at Zhuhai is displaying samples of smart weapons by both the parent company and its subsidiary GosMKB Vypel and GosMKB Raduga. The weapons designed to kill surface targets includes the Kh-35UE guided missile featuring flexible target guidance and attack programming and the high-speed Kh-31AD. Both are designed for use against surface ships and transport vessels (as clustered or individual targets). Kh-35UE can also be used against ground radar contrast targets.

The Kh-59MK air-launched guided extended-range air-to-surface missile is used against a wide spectrum of radar contrast targets ranging from boats to cruisers day or night, VMC and IMC, out at sea and in the vicinity of the shore line.

The class of anti-radiation air-launched guided missiles is represented by Kh-31PDs and Kh-58UShKEs. The former now has got increased speed, range and warhead yield. It is good for use in any meteorological conditions against radar stations of air defense missile systems.

The Kh-58UShKE missile is used to destroy ground radar stations (operating in pulse emission mode in the carrier frequency range of 1.2 to 11 GHz and in continuous A-band emission mode). The missile can be used against both preset targets and those detected operationally by the aircraft target designator system.

The air defense sector is represented by the RVV-MD, RVV-SD and RVV-BD air-launched air-to-air guided missiles with the range to 40-200 km. They are equipped with all-new homing systems with improved sensitivity and ECM resistance. According to TMC CEO Boris Obnosov, the use of a wide range of air weapons during the military operation in Syria helped to significantly improve the performances.

Su-57 to enter service in 2019

In eight years after its first flight, Sukhoi Su-57 fifth generation fighter has finally got its first order from the Russian military. The contract for the delivery of the first production Su-57s between the Defense Ministry and the aircraft manufacturer, United Aircraft Corporation was in August.

“The Defense Ministry plans to receive 15 production aircraft in the nearest future”, said the deputy minister Alexey Krivoruchko. The first fighter is to be handed over in 2019.

Su-57, earlier known as Sukhoi T-50, was developed under PAK FA program to replace 4th generation Su-27/30 Flanker aircraft in the Russian Aerospace Forces. It made its first flight in 2010. As for now ten prototypes were involved in the flight test program. Two more airframes are used for the ground tests.

In February, two Su-57s were spotted at the Russian military base in Syria where they have been tested in combat operations. Krivoruchko confirmed today these trials had been successful.

Meanwhile, the Russian military seem to wait for the fighter to meet all the operational requirements to start larger procurement. The deputy defense minister mentioned the deliveries of Su-57 with the new engines were expected to start since 2023.

The fighter is now powered with Al-41F turbofan engines (previously known as Izdelie 117). This is a derivative of Al-31F powerplant family used at Sukhoi Flanker family. Its 117S variant with 14.5 tons thrust is installed at Sukhoi Su-35S fighter.

The flight tests with new more powerful engines dubbed Izdelie 30 (Item 30) started in December 2017. It was reported earlier that Izdelie 30 increases thrust-to-weight ratio of Su-57 enabling it to fly at supersonic cruise speed.
President-S26T2
The airborne self-protection system for the Mi-26T2 helicopter

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JSC “NII “Ekran” is a benchmark company developing of multifunctional integrated airborne self protection systems for aircraft protection against enemy air defense guided missile systems, as well as terrorist groups widely using modern man portable air defense systems (MANPADS). The company is a member of JSC «Concern Radio-Electronic Technologies» of State Corporation «Rostec».

JSC «NII “Ekran” is proud to present its own development – the airborne self protection system (SPS) President-S26T2 for the Mi-26T2 helicopter, which is the modification of the basic optical-electronic SPS President-S.

Purpose
The SPS President-S26T2 is intended for protection of the world biggest military transport helicopter Mi-26T2 (export version) against MANPADS attacking IR seeker guided missiles.

Structure
The SPS President-S26T2 consists of:
- Missile approach warning system based on 4 UV direction finders (MAWS);
- Laser directed infra-red counter measure system fulfilled in 2 pods (Laser D IRCM);
- Counter measure dispensing system for 50 mm cartridges (CMDS);
- Electronic control unit with external memory (ECU).

Key specifications
The SPS President-S26T2 provides:
- protection for the helicopter in the given coverage area;
- detection and countermeasures to attacking MANPADS IR seeker guided missiles at all missiles application ranges;
- situational awareness and control of the SPS President-S26T2 behavior with displaying information on the multifunction display;
- the helicopter crew with speech messages about attacking missiles. The SPS President-S26T2 weight without flare cartridges and the cabling is not more than 380 kg.

SPS President-S26T2 components

Missile Approach Warning System (MAWS)
The MAWS is based on 4 UV direction finders and intended to detect attacking missiles by means of UV missile engine plume radiation. The MAWS transfers angular coordinates information into the ECU during the missile launching and at its boost path. 4 UV direction finders provide 360° coverage on azimuth and 90° coverage on elevation for the protected helicopter. They are installed in two pods of the Laser D IRCM system.

Laser Directed Infra-Red Counter Measure System (Laser D IRCM system)
The Laser D IRCM system consists of two identical pods installed at Mi-26T2 helicopter boards. The Laser D IRCM system countermeasures to attacking IR guided missiles by means of laser radiation.

Counter Measure Dispensing System (CMDS)
The CMDS is intended for placement and shooting out of 50 mm flare cartridges. The CMDS operates in automatic and manual modes. In automatic mode the CMDS is controlled by the ECU. In manual mode the CMDS is controlled from the cockpit control panel.

Electronic Control Unit with External Memory (ECU)
The ECU is intended for receiving and processing of the SPS President-S26T2 components and onboard radioelectronic equipment data, sending of control commands and information according to preset algorithm into the SPS President-S26T2 components and onboard radio-electronic equipment of the helicopter.

External Memory (memory card)
The external memory is intended for:
- storage and sending a special software file from nonvolatile storage on the SPS President-S26T2 ECU request;
- data recording and storage by the objective control system (OCS);
- transferring of OCS information into the SPS President-S26T2 support facility.

SPS President-S26T2 principle of operation
The principle of operation of the SPS President-S26T2 is based on detection of attacking missiles and their IR seekers countermeasure by means of laser radiation and flares. The helicopter is protected in automatic mode without a crew participation.
Russia's UAC becomes largest warplane manufacturer

Russia’s United Aircraft Corporation (UAC) has become the largest manufacturer of fixed-wing combat aircraft in the world. The company’s annual report says it delivered 94 warplanes in 2017, including fighters and bombers.

UAC insists it took the lead among the global aircraft manufacturers. Lockheed Martin delivered 74 combat aircraft last year: 66 F-35s and eight F-16s. Boeing reported 39 deliveries, including 23 F/A-18s and 16 F-15s. France’s Dassault handed over nine Rafales. Eurofighter Typhoon has not yet reveal its deliveries for 2017. UAC did not report its deliveries breakdown by customer types, but Russia’s Kommersant daily reported earlier this year that Russia had exported 33 newly assembled combat aircraft in 2017. These included 10 Sukhoi Su-35 fighters for China, six Su-30MKAs for Algeria, two Su-30SMs for Kazakhstan, and 15 MiG-29M/M2 fighters for Egypt.

With these figures taken into account, a total of 61 aircraft must have been handed over to the Russian military. The Russian Aerospace Forces continue to expand their fleet of Gen 4++ Sukhoi aircraft. In 2017, the military took deliveries of single-seat Su-35S and twin-seat Su-30SM fighters, as well as of Su-34 bombers. The Russian Defense Ministry announced in January that it had received more than 110 new aircraft in 2017, but this figure is believed to include both fixed- and rotary-wing types.

UAC plans to assemble 2,450 military aircraft through 2035, increasing its market share to 45% compared to 20% in 2015. Domestic procurement will be financed under the new governmental armament program for 2018-27.

Su-30SM to get new engines

The Russian military has ordered more than 100 Su-30SM fighters for both the Air Force and the Navy. Since 2012 the Russian military has ordered more than 100 Su-30SM for both the Air Force and the Navy. This aircraft is latest version of Russia’s export bestseller, the Su-30MKI family. The largest foreign operator of these fighters is India. It is also in talks with Sukhoi over the modernization of its fleet. Algeria, Malaysia and Kazakhstan also have fighters of this family.

Thrust without afterburning is 8,800 kgf against 7,700 kgf at the current engine.

The standardization is also a good reason as Su-35S and Su-30SM heavy fighters will be a backbone of the Russian Air Force at least for the next decade.

Yury Slyusar, the head of United Aircraft Corporation, a parent to both Sukhoi and Irkut, told in 2017 that the modernization dubbed Su-30SM1 may also include the installation of new avionics and the introduction of new air-launched weapons as well as the improvement of maintenance procedures to reduce the operation costs.

Since 2012 the Russian military has ordered more than 100 Su-30SM for both the Air Force and the Navy. This aircraft is latest version of Russia’s export bestseller, the Su-30MKI family. The largest foreign operator of these fighters is India. It is also in talks with Sukhoi over the modernization of its fleet. Algeria, Malaysia and Kazakhstan also have fighters of this family.
Right on target

Tactical Missiles Corporation

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China-friendly Russia and Russia-friendly China?

China is a huge country with a population of almost 1.5 billion people and has bold ambitions of sustaining its growth rates which have been high for the last two decades, until recent years when a decline set in. Air transport appears to be a pivotal element for China’s economic growth — and all of this contains significant consequences for Russia.

Ekaterina Sorokovskaya and Alexey Sinitsky

Civil aviation will continue to play an essential role in China’s economic and social development, ICAO secretary general Fang Liu announced at the Belt and Road Forum for International Cooperation which took place in Beijing in May last year. According to the high-ranking official, strategic and aggressive investment in air transport development will be the key success factor for China’s new large-scale initiative because it is air services that generate direct and indirect socio-economic benefits, the secretary general pointed out.

In recent years, the Chinese air transport sector (both domestically and internationally) has been registering an unparalleled upswing. This is attributable to the fast growth of the country’s middle class, from which consumer spending on entertainment, healthcare and online shopping has increased and which will continue to rise significantly in years to come. People will also spend more on traveling, boosting demand for air transport services.

According to the Civil Aviation Administration of China (CAAC), in 2017 the three largest air companies in the country — China Southern Airlines, China Eastern Airlines and Air China — each registered traffic numbers of more than 100 million passengers, while the overall market itself grew by 12.6 per cent. Last year, the combined traffic performance of all Chinese carriers reached some 549 million passengers.

China Southern, the country’s biggest airline, last year carried 126 million passengers, 10.2 per cent more than in 2016. Its domestic traffic grew by 10.3 per cent to 92.6 million passengers, whilst international flights generated 15.4 million passengers, an increase of 11.1 per cent.

China Eastern carried 111 million passengers last year, nine per cent more than in 2016. The most impressive improvement — a 10 per cent increase up to 92.6 million passengers —
was achieved on domestic flights. International services accounted for 14.7 million passengers (up 2.4 per cent over 2016).

Air China, the last of the nation’s big three air carriers, cleared the psychological barrier of 100 million passengers last year, registering traffic of 101.6 million passengers (+5.1 per cent). Some 83.5 million of that total (+6.0 per cent) were covered by domestic services and 13.5 million (+2.0 per cent) by international.

Remarkably, each of China’s big three airlines currently handles as many passengers as the entire Russian commercial aviation business. Nevertheless, Russia’s Aeroflot still leaves them behind in terms of international traffic, with more than 17 million passengers. Apparently, China’s available resources and enhanced capacities point to promising assets for boosting future international services, but which, for a number of reasons, have not yet been fulfilled.

China is in the process of building new airports and revamping and expanding many of its existing air hubs. In 2017, the nation brought 11 new airports into operation, raising its total number of gateways to 229. Last year, airports in China reported a traffic turnover of more than 1.148 million passengers, representing a 12.9 per cent improvement on 2016; and traffic at 32 individual airports exceeded 10 million passengers. The nation’s strategic plan promises that 136 new airports will be built by 2025.

Meanwhile, air transport companies in China have been affected by competition from elsewhere, with passenger traffic growth rates suffering since the Gulf carriers of Emirates, Etihad and Qatar Airways started to draw clients to their Middle East hubs conveniently located between Europe and Asia, and by offering affordable ticket prices along with top-quality services. Nevertheless, according to the International Air Transport Association (IATA), China will soon outpace the USA and become the world’s largest aviation market by 2022 as global passenger traffic passes the 1.5 billion people mark.

It is becoming increasingly obvious that China’s rapidly expanding aviation business is not just challenging the largest American and European air carriers, but the emerging Chinese air companies are also forcing their competitors to look over their shoulders. With the recent slowdown of economic growth in China affecting profit margins, China’s airlines, in order not to lose momentum, are now actively pursuing two strategies: expansion in foreign markets, and the development of the low-cost carrier segment. The Chinese middle class is again the factor influencing the foreign expansion plans, with Chinese passengers opting to choose Chinese carriers that they are comfortable with.

China’s robust upturn in outbound tourism is a consequence of improved living standards and the now relaxed visa requirements for Chinese citizens in many countries around the world – two key drivers in the trend for increasing numbers of international travellers. However, there are three other major factors that are contributing to the enhanced growth of passenger traffic on international flights: firstly, with all three big Chinese air carriers being state owned, the national policy is encouraging the need to be more aggressive in the international flights segment, with a stimulation toolkit that may well include both soft incentives like satisfying preferences (such as more convenient slot

### The most popular foreign destination carried by Russian airlines, scheduled services

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Source: ATO Sourcebook’2018
The new silk road

In the autumn of 2013, Xi Jinping, president of China and party general secretary, introduced the concept of the Silk Road Economic Belt (in reference to the historical Great Silk Road from China to Europe as mentioned in 1877) and the Maritime Silk Road. The two concepts later formed the initiative of the One Belt, One Road (also known as Belt and Road Initiative) which is aiming at re-creating a streamlined transport, energy and trade corridor between the countries of Central Asia and Europe. The initiative aims to foster scientific and technical cooperation and enhance economic ties between states along the route. As of today, more than 80 countries and international organisations have signed up to intergovernmental agreements and memoranda of understanding with the government of China.

Secondly, the airlines themselves are becoming excited about the opportunities that international routes may offer. Factor number three, surprisingly, is a technical one. Many Chinese carriers are now facing a lack of slots for airfield operations on domestic flights as a result of out-dated airport infrastructure and restricted handling capacity. A domestic flight requires two slots — one for take-off and one for landing — while an international flight needs only one, as the second is provided by the foreign airport. As a result of this factor, it is in the international flights sector where Chinese air companies may be able to use their seat capacities even more efficiently.

The Belt and Road initiative, as well as the transport communication plans of countries participating in the project, stipulates that Chinese and foreign airlines will launch more than 100 new international flights between cities and regions embraced by the initiative. Almost one third of those destinations will link China with cities in Russia and central, south-east and south Asia.

China-friendly Russia

The Moscow hub airport of Sheremetyevo is currently the most popular among Chinese airlines. It is the only European gateway that serves flights of eight Chinese carriers: China Southern Airlines, China Eastern Airlines, Air China, Tianjin Airlines, Hainan Airlines, Sichuan Airlines, Beijing Capital Airlines and Lucky Air. In 2017, traffic between Sheremetyevo and China exceeded 100 million passengers annually – the same total of the entire combined Russian commercial aviation industry.
two million passengers, a 17 per cent improvement on 2016.

Flights to and from China have been steadily on the increase from the Moscow airport, Russia’s biggest. As of the summer of 2016, Sheremetyevo’s destination network in China included 12 airports. In 2017, China Southern Airlines, Beijing Capital Airlines, Tianjin Airlines and Lucky Air added services to Shenzhen, Quindao, Chongqing and Kunming and, in the 2018 summer schedule, the number of Chinese destinations increased to 16. The special relationship will continue to grow, as will the number of frequencies within the existing services. In June of this year, Air China increased its weekly frequencies to Beijing to 14, and a month later Hainan Airlines increased the number of flights to the capital of China to 10 weekly frequencies. Beijing Capital also launched a new destination, to Hangzhou.

The list of Russian airlines performing flights from Sheremetyevo to China includes Aeroflot and Royal Flight, the latter launching flights to Guiyang, the capital city of Guizhou province. In March 2017, Sheremetyevo was the first Russian airport to be awarded the China Friendly certificate, with the hub proving that it complies with high service standards for Chinese passengers, offering readable website information, audio announcements and airport navigation signs in Chinese. Other friendly features include, UnionPay and Alipay support at restaurants and cafes in the duty-free zone, as well as Asian cuisine and menus translated into Chinese.

Sheremetyevo’s rival Moscow airport of Domodedovo offers flights to two Chinese cities: Urumqi (operated by S7 Airlines) and the Hainan resort of Sanya (Azur Air). Last year, Lucky Air carried out its flights from Kunming to Domodedovo, but later followed other HNA Group members (Hainan Airlines, Beijing Capital Airlines and Tianjin Airlines) and switched to Sheremetyevo. The de-

In May 2018, Hong Kong Airlines launched a direct flight from Hong Kong. So far flights are being operated until the summer schedule is over (October 27), and whether they will be prolonged depends on seat occupancy rates.

Meanwhile, the carrier is also considering flights to St Petersburg’s Pulkovo Airport which, as with Sheremetyevo, is looking to foster further cooperation with Chinese carriers. The gateway was granted the Welcome Chinese certificate of the China Tourism Academy in December 2016. As of 2017, three Chinese air companies served St Petersburg’s Pulkovo directly from Beijing (Hainan Airlines), Urumqi (China Southern Airlines) and Shanghai (China Eastern Airlines). In January 2018, Sichuan Airlines commenced regular operations between St Petersburg and Chengdu (Sichuan province), while in May 2018 China Eastern Airlines launched flights from Xian (Shaanxi).

Elsewhere in Russia, in June 2018, Tolmachevo Airport in Novosibirsk became the first regional hub — and

the second in Russia (after Sheremetyevo) — to be certified by the China Friendly programme. Passengers from China have been showing interest in Novosibirsk as a transfer hub for trips to European Russia (Moscow, St Petersburg, Kazan, etc)

Russia-friendly China?
The Chinese market seems to be inexhaustible — and that in itself is attracting foreign and Russian carriers, but another hefty boost is coming from those local authorities which actively subsidise long-range air services from Chinese second-tier cities (other than from Beijing, Shanghai and Guangzhou). No one should be misled by the term ‘second-tier’ though — because it still refers to cities with populations of dozens of millions of people. Subsidies at Chinese airports differ from those typically present in other aviation markets which usually cover (fully or partially) just airport fees and some marketing support. Of course, more generous subsidies may also be available, but they can barely compete with some Chinese regimes, with incentives which sometimes generate 30 to 50 per cent of a flight’s revenues for
the company. One such example is Qingdao, which contributes $12,300 for each flight of a 200-seat aircraft service to other Asian cities.

It is believed that the total amount of China’s aviation subsidies is now estimated to exceed $1.3 billion, as such subsidies may also last for a long time and cover more than just the first one or two years’ of flight operations. The most unusual thing about Chinese subsidies is that they are meant to mostly favour outbound tourism. Although it is common practice across the globe for airport subsidies to indirectly be evened out by revenues generated by incoming tourists and growing businesses at home, on the contrary, air traffic in China’s second-tier cities is almost entirely aimed at serving Chinese tourists going abroad to holiday destinations. For example, Xian pays Finnair for transporting Chinese tourists to Europe, but very few Finns (or other Europeans) head for Xian to help generate a noticeable economic effect. And yet, from a foreigner’s perspective, Xian, with its Terracotta Army, seems a more attractive destination than say Changsha or Wuhan, which offer hardly any attractions. Subsequently, the subsidisation policy has stimulated a steady growth of long-range air services from second-tier Chinese cities. The average number of such flights has gone up from two to 31 per day over the last 10 years.

However, in late 2017, all three major Chinese airlines expressed doubts about the continuation of the subsidisation policy and pointed out that those particular air services have remained low-profit and would cease as soon as the subsidies are scrapped. The call to axe the subsidies voiced by the Big Three can also be considered as a move to upset local competitors (mainly, the private HNA Group that accounts for 31 per cent of flights from second-tier cities, as well as foreign companies).

How long this subsidisation policy will continue remains an open question. The records show it is problematic for a foreign company to introduce or sustain such a subsidy regime — the Chinese prefer to keep the money within the existing business-schemes.

Yet, despite this thorny issue, the Chinese market still looks an extremely attractive one — or maybe even over-the-top, observers wonder. One of the reasons for Russia’s VIM-avia’s fiasco in 2017 was its failed attempt to get a grip on Chinese destinations. To achieve this goal, the company had expanded its wide-body fleet half a year earlier than planned and, due to some unexplained reasons, failed to develop the services – and eventually faced a cash-flow gap that was too wide to bridge. Currently, several other Russian airlines are following in VIM-avia’s footsteps regarding the Chinese destinations. We cannot but hope that they will be able to walk all the way to the end.
Anna Nazarova

Political sanctions, the gradual isolation of Russian businesses in the global economic arena, vague perspectives for the Russian business elite — these are the main factors currently shaping the future of the country’s business aviation market. Despite this, the present remains surprisingly bright, as the industry is on an upward flightpath, having recovered from previous crises.

Floating traffic
Russia’s business aviation industry flew into 2018 on an upswing. According to Eurocontrol data, in 2017 the number of business aviation flights in Europe climbed by six per cent, exceeding 700,000 flights, which translates to an average of 100 additional flights per day.

Brandon Mitchener, general director of the European Business Aviation Association (EBAA), has expressed a strong belief that business aviation has become an integral part of the general mobility. New solutions and services have made business aviation more affordable and raised its profile among younger people, resulting in a steady growth of traffic since November 2016. The highest growth was registered in March (up nine per cent year-on-year), July and October (up 8.9 per cent) on 2017, boosted by increased activity in central European countries, such as Slovakia (30.9 per cent growth), Bosnia and Herzegovina (25.7), and the Czech Republic (13.8). Business activity in the European Union is nearing the record levels of 2006, a year which preceded the most prosperous period in the history of business aviation, namely 2007 and 2008.

The German consultancy Wings Advance notes similar optimistic trends. The analysts reveal that 2017 was marked by a four per cent up draught compared to the previous year. The number of business aviation flights grew throughout Europe and in Russia, whilst France’s Nice and London’s Biggin Hill airports once again were the most desired destinations.

Russian business aviation operators have also confirmed that the market has become more lively, with demand for private and corporate aviation spurred by international forums, congresses, summits and exhibitions, as well as prominent sports events — all those get-togethers, that focus demand for travel.

Vitaliy Tereschenko, first deputy CEO of Russian operator Sirius Aero, reveals: “If you compare the season, which started in December 2017 and ended in March 2018 with the same period in 2016–2017, Sirius Aero showed a 19 per cent growth, which is largely attributed to fleet expansion. At the same time the market average growth was between four and five per cent.”

According to Tereschenko, in late 2017 and early 2018 the market followed a typical cycle — December became one of the busiest months in the year, and whilst the demand went into a natural
dive after the holiday season, it picked up again in February with more business trips and the ongoing ski season.

Another operator, Kazan-based Tulpar Air, has also noticed the general tendency towards growth in all types of air travel services, including charters, although no figures have been disclosed — as is the same for its colleagues at Jet Express. Irrespective of them being tight-lipped about the operational results, the companies note a curious trend: in the period that covered the second half of 2017 and the first half of 2018 there is a clear tendency towards increased numbers of flights in the typically low seasons, namely early December, February and March. There’s also rising demand for flights within Russia, indicating the gradual transformation of business aviation from being primarily a luxury segment towards becoming a standard business tool.

The preferences of charter users in 2017 inclined towards midsized and heavy business jets. Passengers still prefer flying with a company of friends and partners, or will contract a jet for family vacations. The list of charter market aircraft leaders is topped by the Bombardier Challenger 604/605/850, the smaller Cessna Citation XLS/XLS+, and the Embraer Legacy 600/650, which enjoys enduring popularity with Russian passengers. This data is provided by Aim of Emperor group and is based on the commercial charter and private flights statistics of the Russia-originated company.

The destination preferences of business passengers have remained surprisingly consistent through the years. Large market players agree that Europe is still number one for Russian travelers, more specifically Nice, London, Paris, Berlin, Geneva, Milan, Vienna, which are joined by Pisa and Chambery in the summer and in the winter. Within Russia — Moscow, St Petersburg, Sochi, Rostov-on-Don, Kazan and Yekaterinburg — retain their positions of preferred destinations. Simferopol is also on the list, however no operator would dare admit it as they would not risk flying a business jet with a foreign registration to Crimea for fear of breaking sanctions.

Prices for charter flights remain under pressure from fierce competition against a backdrop of stable, albeit moderate demand. Prior to the crisis of 2014 (let alone pre-2008 crisis times), the charter broker business has enjoyed high margins, thanks to a number of factors. However, the countrywide cost optimisation sweep has reached private aviation as well, prompting price damping, the hunt for empty legs, and often more attractive prices for passengers. All this shaped the market conditions that favoured new clients’ introduction to renting a private jet. In Europe, the price for chartering a smaller jet like the Embraer Phenom 100/300 does not exceed €10,000.

**Unchanging consistency**

The fleet of ‘provisionally-Russian’ business-jets (de facto those owned by Russian citizens, but registered and operated outside the country) is the ‘measure of things’ — which characterises the real condition of the business aviation market, and the country’s economy in general. Whilst charter flights are the most popular but also the more vulnerable and fluctuation-prone segment, the private aircraft fleet is a more significant factor, and is not season-sensitive.

Owners of private aircraft are also owners of the largest corporations in the country, with a resource-based economy which does not stimulate new aircraft owners, but on the other hand keeps the list of existing ones relatively intact. So the fleet of ‘Russian’ business jets hardly changes in number over the years.

There is still no official data, but according to subjective assessments, the figure fluctuates between 350 and 500 aircraft. Of this only 74 are listed on the national register, according to JetNet. The reasons for such a low rating on the Russian aircraft register are well known not only to private owners, but also to the largest commercial airlines, including flag carrier Aeroflot, which has the major share of its fleet sporting Bermuda’s VP- and VQ- prefixes on its tails. Russian business aviation operators currently do not see any tendency towards registering their private jets under RA-jurisdiction.

“An owner identifies the suitable register for his aircraft based on his needs,
objectives and the plan for using his aircraft,” explains Vitaliy Tereschenko of Sirius Aero. “Our airline has several aircraft on the Russian register, and several more registered in Bermuda. In the latter case we operate the aircraft in compliance with the Part 83bis of the Chicago convention, as a Russian airline. We believe this to be the most efficient and reliable scheme.”

Sergey Trifonov, of Tulpar Air, admits: “There’s no tendency towards transferring aircraft onto the Russian register. The fancy of the Transport ministry is not really supported by any benefits of such a transfer.”

Despite the low popularity of the Russian register, there are a number of Russian airlines which operate successfully with aircraft with the RA- prefix on their tails. The largest of these are Sirius Aero, RusJet and Aeroservice. Sergey Trifonov explains that the major advantage for locally based/registered airlines is their unrestricted ability to operate domestic flights, better flexibility and reduced waiting times due to their aircraft being closer to potential customers, and Russian-speaking crews. This view is shared by Sirius Aero, whose spokesman emphasises that, within Russia, local operators benefit from more privileges, such as lower airport and ground handling fees, access to government and military airports if necessary and unrestricted cabotage whilst being compliant with customs regulations.

However, foreign-registered aircraft operators such as Vista Jet, Global Jet Concept, Air Hamburg, and Jet Story enjoy the same level of success in the Russian market, and have their own list of advantages in the eyes of aircraft owners. These attractions include transparent history of operations, which is key to re-selling the aircraft in the secondary market, favourable taxation, and ample possibilities for the raising of finance for a business jet acquisition. For passengers there’s also the high chance of catching an empty leg to Europe, which saves between 30 and 70 per cent of the charter’s cost.

Aircraft for sale
The market of used business jets for sale is another major factor for the industry. The Russian used aircraft market is closely aligned with the global market, which is now characterised as a seller’s market, one defined by a period of economic growth which has spurred increased demand for aircraft, hence higher asking prices. According to JetNet data, as of April 2018, about 9.3 per cent of the world’s collective fleet of 21,607 business jets were up for sale. JetNet’s methodology stipulates that the sellers’ market is characterised by less than 10 per cent of the global fleet being on sale. So it may be assumed that the period of attractive offers and discounts is nearing its end, and the prices are moving closer to realistic market values. According to estimates from LIS Trading Group, which is also an aircraft broker, the market of used jets has shown signs of revival lately, as it is now attracting a new category of clients working on their first business jet purchases.

“In the last few month we have seen a steady increase in the number of requests for the search of aircraft in the price range of around $6 million. In this price category the Embraer Legacy 600 has won unrivalled success, which is beginning to influence its asking price. The secondary business jet market is entering the sellers’ market phase, and buyers should hurry up with their purchase decisions,” advises Roman Malyushkin, managing partner at LIS Trading Group.

In conclusion, it can be observed that 2018 started out as a year of promises. The growth of charter traffic, the revival of the used jet market — all these are indicative of the Russian business aviation’s steady and cyclical development. It is likely that the market will continue strengthening, unless external political and economic cataclysms push it into a reaction.
Uncertain future of International Space Station

By Igor Dmitriev

This year marks two anniversaries in the history of the International Space Station (ISS), the largest space exploration effort to date. 25 years ago NASA and Russia’s Roscosmos signed the Space Station Program Implementation Plan while the Zarya Functional Cargo Block launch, which signaled the beginning of ISS construction was launched 20 years ago. The ISS’s future is currently uncertain, but is expected to be decided in the next several months.

The ISS is based on two space station projects, Russia’s Mir 2 and the US’s Freedom, which were never implemented separately. It incorporates the operational experience of the Soviet orbital stations and the US Space Shuttle vehicles. Once the program had been finalized legally and technically, work on the station was begun by the 16 participating countries: the US, Russia, Japan, Canada, and Brazil, as well as 11 ESA members (Belgium, Denmark, France, Germany, Italy, the Netherlands, Norway, Sweden, Switzerland, and the UK). Each country was expected to contribute reasonably to the program’s implementation, the idea being that broad cooperation would help cut the construction costs and times. However, expenses started growing at a fast pace and exceeded $150 billion in 2010. Brazil bowed out of the program in 2002.

In terms of operation the ISS comprises the Russian and US segments. The former is managed by the mission control center in Korolev, outside Moscow, and the latter by the control centers in Houston, Germany’s Oberpfaffenhofen, Japan’s Tsukuba and Canada’s Saint-Hubert. The station currently includes 16 modules; another three, the Nauka multipurpose laboratory model, a nodal module, and a science-power module, are to be added in the next several years.

Weighing in at around 420 tons, measuring 51 by 109 by 73 meters, commanding a pressurized volume of 916 m³ and 388 m³ of living quarters, the ISS is the largest artificial object ever launched to near-Earth space. It is currently flying in an orbit with an inclination of 51.6°, at altitudes of between 400 and 450 km, and with an orbital period of 90 minutes. Since first put into operation, the station has completed around 114,000 orbit passes and hosted 232 persons from 18 countries.

The station’s complement crew comprises six persons; the ISS has been permanently manned since 2000. Crew conduct experiments in biology, medicine, physiology, astronomy, meteorology, physics and chemistry, as well as carrying out space technology research and regularly launching nanosatellites.

The ISS experiments have yielded impressive results. In particular, the AMS-02 (Alpha Magnetic Spectrometer) device was used to conduct important research into dark matter. The spectrometer, which detects elementary particles, weighs 8.5 tons and costs $2 billion. It was developed by an international group of scientists representing 16 countries with funding from the US Department of Energy. Between May 2011 and April 2013 it registered around 100,000 positrons. This abnormal level of antimatter may indicate the existence of dark matter.

Other ISS-hosted experiments have also been successful. For example, medics and physiologists have been able to develop food rations and physical exercises aimed at reducing the speed at which crew on long missions lose bone mass, which is one of the key problems to be solved in the interest of future interplanetary missions.
Research demonstrated a decrease in crew’s vision caused by changes in the intracranial pressure on the eyeballs. “It’s probably the most significant discovery we’ve made in space physiology in 20 years,” commented US astronaut Michael Barratt, who had spent over six months on the ISS as part of two expeditions back in 2009.

ISS crew conduct applied research and experiments that facilitate the creation of new space equipment. In particular, US astronauts study capillary behavior of liquids in microgravity, which will be useful in developing fuel tanks and fuel pipeline systems for future spacecraft and boosters.

Despite the progress made to date, the ISS cannot keep going forever: its components will eventually reach the end of service life, and the program participants have their own ideas as to the station’s future. The program was originally scheduled to last until 2010, but the deactivation date has been repeatedly postponed. In 2016, the participants agreed to continue operating the ISS until 2024, after which it was to be deorbited and sunk in the Pacific. Now, however, various variants are being considered for the station’s active service to be prolonged beyond that date.

The partners have been mulling the possibility of continuing with ISS operations until 2028, but no decision has been made so far. The USA spends some $4 billion per year on the station’s maintenance, which limits the possibility of implementing future space projects, so NASA has been looking to have the US segment privatized. “At present the ISS is scheduled to remain operational until 2024. The president’s budget request has said that we are going to end the direct funding in 2025 with the intent to commercialize the low-Earth orbit in 2025. So, that is being said and I support that policy,” NASA Administrator Jim Bridenstine said during his October visit to Russia. “The Congress is maybe looking to extending it to 2030. There is a bill in the House [of Representatives] and a bill in the Senate that would do that.” He added: “Of course, as NASA administrator I will follow the law, whatever law Congress passes.”

Bridenstine added that the intent is for NASA to be one customer of many customers operating in the low-Earth orbit and to have multiple providers that are competing against each other on cost and innovation: “If we can have a competitive market place in low-Earth orbit for human habitation where NASA can be one customer of many customers, and we have multiple providers competing on cost and innovation, it drives down our cost, it increases access, and then NASA can use its resources to go further.”

He added: “And in order to go further we need to free up resources that are currently in the low-Earth orbit, and so we free up those resources by commercial operations and then use NASA’s resources to go to the Moon and on to Mars.” NASA is in talks with a number of international companies over delegation to them of the ISS management and funding functions. “There are people out there that can do commercial management of the station”, Bridenstine said shortly after assuming office at NASA. “I’ve talked to many large corporations that are interested in getting involved in that through a consortium, if you will.” The White House is planning to ask Congress for $150 million to be allocated in the 2019 budget for enabling privatization of the ISS.

However, Congress may have its own view of the matter. The bill mentioned by Bridenstine was discussed by the congressional subcommittee on space on September 26. The legislators do not want China’s orbital station, which is to be launched in 2022, to remain humanity’s only low-orbit outpost.

NASA, which is planning to focus its efforts on deep-space missions, needs more time to handing over its low-orbit operations to private contractors. The agency is additionally worried by the hold-ups in the development of the private Dragon and Starliner manned spacecraft, whose operation will not begin until 2019 or 2020. This is why Senate, and then Congress, supported the plan to prolong the ISS operation through to 2030. Senator Ted Cruz, head of the house’s committee on space, commented: “One of the dumbest things you can do is cancel programs after billions in investment when there is still serious usable life ahead.”

Not all US specialists are squarely behind the ISS privatization idea. Frank Slazer, Vice President Space Systems for the Aerospace Industries Association, believes that the very principles of the station’s operation do not allow for its commercialization: the ISS is governed by intergovernmental agreements.

This is why it is highly likely that the term of the station’s operation will be prolonged again. Roscosmos will probably has nothing against such a decision, seeing as there are currently no ready alternative to the existing
manned space exploration program. In 2014, Russia considered the possibility of building a national high-latitude station and withdrawing from the ISS beyond 2020; there was also a proposal to turning the Russian ISS segment into a national orbital station after the international project has been discontinued, but no decision was made on either of these plans. The European partners will most likely support the idea of prolonging the ISS operations, for similar reasons as Russia. EU bureaucracy means a final decision will take some time, but there is no particular rush.

Interestingly, one proponent of the ISS’s commercialization is the Russian company S7 Space, which operates the Sea Launch and Land Launch projects and specializes in space launch and orbiting services. Recently, S7 Space proposed using the ISS as a cosmodrome, which would significantly expand the company’s range of commercial services. Specialists are looking into the possibility of assembling large space systems on board the station for further launches to geostationary orbits, towards the Moon, and to escape trajectories. Another use for the ISS might be as a maintenance base and a hub for space tourists.

All these ideas could be implemented within the next 10 to 15 years. In the meantime, the plans for the ISS may be significantly revised in the light of the current situation, including the October 11 failed launch of a Soyuz-FG rocket carrying the Soyuz MS-10 manned mission to the station. The ISS partners are now looking into what changes need to be made to the station’s operation plan. Manned flights to the ISS have been suspended. Normally, in such situations, manned missions resume after two successful unmanned launches in a row. On the other hand, there have been exceptions to many programs recently.

The ISS may be operated automatically, without crew on board. However, Sergey Krikalev, Roscosmos’s executive director for manned programs, believes every effort must be made to prevent such a scenario. Mothballing the station and then reactivating it again would require much time and money. This would also jeopardize the plan to launch NASA crew commercially, on board Starliner and Dragon Crew vehicles, which are not going to be put into service until 2019. (Seeing as the launch dates for the new US manned spacecraft have slipped repeatedly, and may yet be revised in the future, NASA has been playing it safe by booking seats for its astronauts on Russian Soyus vehicles until February 2020.) Overall, even the short-term prospects of the ISS are currently uncertain. Things should become clearer in the next several months. However, one may predict with a high degree of certainty that the station will continue in operation until 2030: the partners have invested heavily in the program and are interested in obtaining new results. “The space station is a world-class facility,” Andrew Clem with the Johnson Space Center said back in 2013. “[It] allows for demonstration of critical capabilities for long-duration human spaceflight and generation of interest in science, technology, engineering and mathematics education.” Five years on, these words are still pretty much relevant.
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