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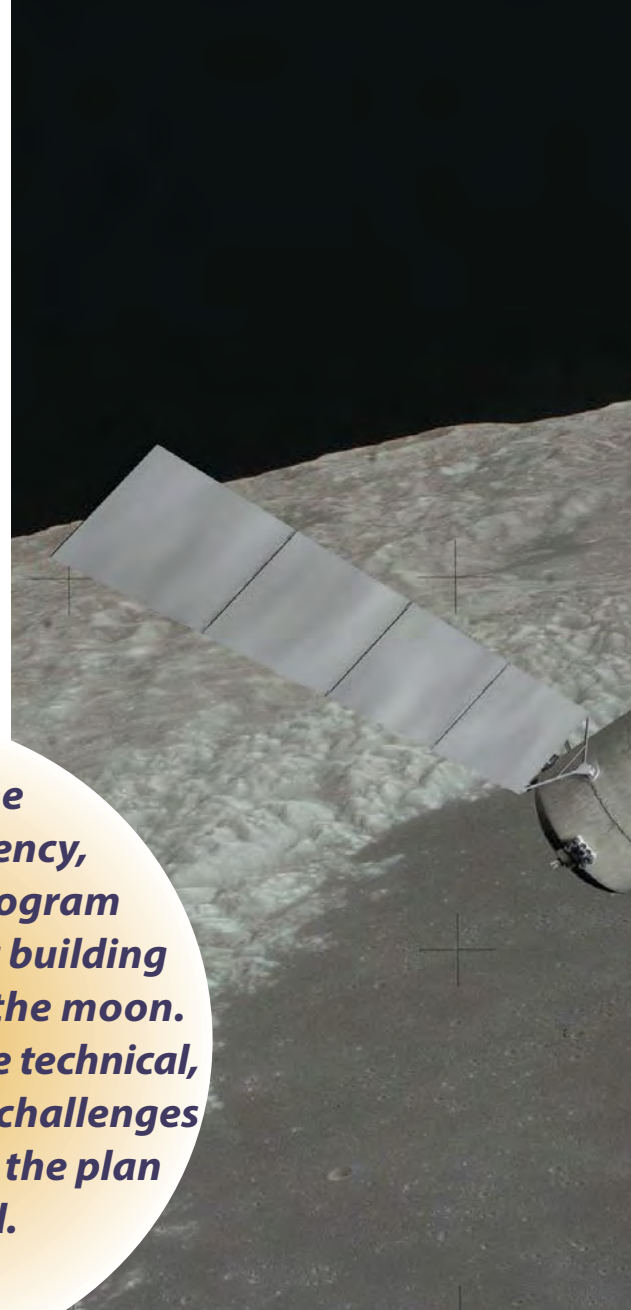
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# Russia shoots for the moon

*Roscosmos, the Russian space agency, has developed a program that sets the stage for building a permanent base on the moon. Anatoly Zak explains the technical, economic and political challenges that threaten to keep the plan on the ground.*

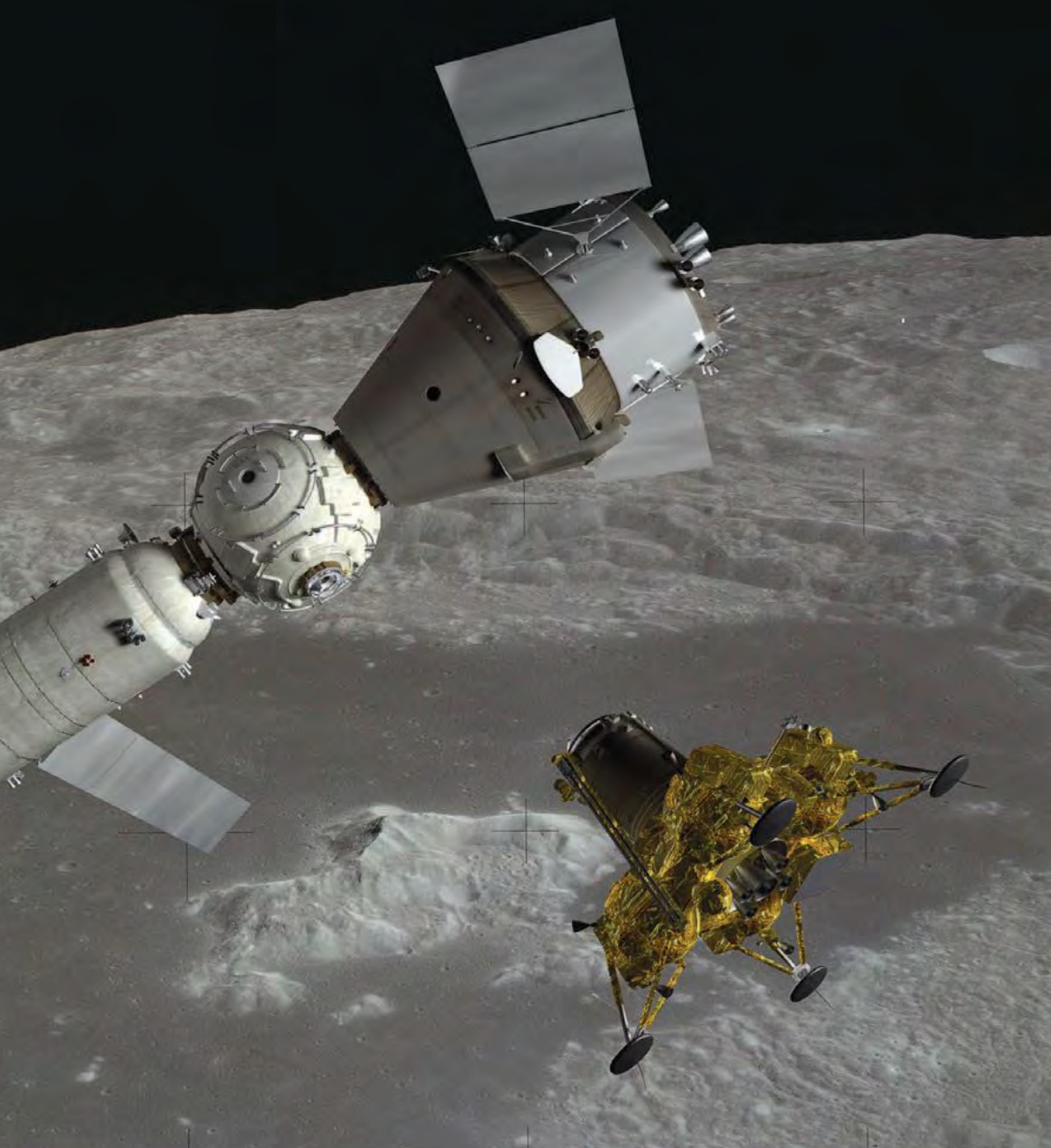


In April 2014, on the eve of the 53rd anniversary of Yuri Gagarin's pioneering flight into space, Russian Deputy Prime Minister Dmitry Rogozin called on the nation to undertake a bold quest: Establish a permanent human outpost on the moon.

Writing in the government daily *Rossiyskaya Gazeta*, Rogozin outlined a lunar cosmonaut program more ambitious than the Apollo project.

"We are not targeting the moon as a limited program in terms of time and resources. The moon is not a way station in a journey but an independent and self-suffi-

by Anatoly Zak



Anatoly Zak

The unmanned Korvet lander carrying samples of lunar soil approaches a manned orbiter in an artist's rendering of a proposed Russian lunar mission. Roscosmos, the Russian space agency, sees the mission as a steppingstone toward establishing a human outpost on the moon sometime after 2030.

cient goal!" he wrote, according to a translation. "It doesn't make much sense to launch 10-12 missions to the moon and then give up everything and fly to asteroids and Mars. This process has a beginning but has no end: We plan to come to the moon forever."

The audacious plan came as a wave of Russian nationalism was building in the wake of the Sochi 2014 Winter Olympics in February and the annexation of Crimea from Ukraine in March. Other factors may have been NASA's plans for the manned Orion spacecraft and China's growing reach into space.

When Rogozin revealed his vision for a

lunar base, rising oil prices were fueling the Russian economy and the country's space budget was growing, from about a half-billion dollars in 2004 to \$4.3 billion in 2013, just short of the European Space Agency's spending. But by the end of 2014, the price of oil had plummeted, new Western sanctions over the Crimean annexation were imposed, and the value of the ruble against the dollar dropped by more than 40 percent.

Rogozin voiced a change of heart.

"Some experts, including those from Roscosmos, tell us, 'Let's go to the moon and let's explore it.' I previously liked this idea myself. But now it is necessary to cal-



Cosmonaut Alexander Misurkin works outside the International Space Station in 2013. Russia is considering new human space flight destinations after the space station is retired.

culate how much money it is going to cost,” he said in a Dec. 24 interview on the Russia-24 news channel.

The question now is not only whether Russia can reach the moon, but what will become of its entire human space flight program.

Russia’s space advocates are not giving up. For more than two decades the International Space Station has been the primary destination for Roscosmos, the Russian Federal Space Agency. But with the station set to be retired within a decade, Roscosmos, like ISS-partner NASA, is seeking new objectives for humans in space. While NASA is laying the groundwork for manned deep-space missions with its Orion program, Roscosmos has an ambitious proposal that comes amid difficult economic times.

The agency’s goals are outlined in its latest 10-year Federal Space Program, known as FKP-2025. The 2016-2025 roadmap sets the strategic direction for all segments of Russia’s civilian space program, including human space flight, unmanned deep-space probes, Earth-watching satellites and orbital observatories.

Roscosmos seeks \$56 billion to carry out the 10-year program, according to a copy of the document.

Oleg Ostapenko, the head of Roscosmos, submitted the program to the Russian government before the end of 2014, and Russia watchers say the proposal has made its way to Rogozin, who oversees defense and space programs.

### Back from the abyss

The Russian space program spent the first post-Soviet decade near a financial abyss. Once additional funds were allocated by the Kremlin at the turn of the century, experts got to work developing science missions, the Angara rocket family and new navigation and Earth-observation satellites, and crafting a long-term vision for Russian human space flight. The authors of FKP-2025 likely believed they had come up with a winning plan, but then came the economic fallout of the Western sanctions and the falling oil prices.

FKP-2025 would lay the groundwork for a goal that eluded the Soviet Union during the height of the Cold War: an expedition to the moon. The Soviet lunar landing effort was abandoned in 1974, two

The Energia-5KV rocket is among several super-heavy launch vehicle concepts proposed by the Russian space industry to help achieve the country's lunar ambitions.

years after the last Apollo landing.

“A timely development of rocket and space technology for lunar exploration will not only provide Russia with a leading position in this field and exclude a risk of other countries’ getting strategic advantage,” FKP-2025 states, “but will also create a powerful ‘locomotive’ effect for bringing all areas of the national space program to the advanced positions in the world during the immediate next phase of the space program.”

FKP-2025 calls for developing technologies that could include the ability to place cosmonauts in lunar orbit while a robotic lander samples the surface. Lunar soil-moving machines and cranes would also be developed under the program in anticipation of establishing a human base on the moon after 2030.

Anatoly Koroteev, the director general of the Keldysh Research Center, a Roscosmos development organization, confirmed that schedule in an email, adding that landing cosmonauts on the moon would not be realistic before 2030.

### The rocket gap

Roscosmos envisions a two-stage effort to land humans on the moon. A pair of rockets would place up to 90 tons of payload into orbit around Earth, including a manned transport ship with crew and an uninhabited lunar lander. The spacecraft would then travel separately and link up in lunar orbit, where the crew would transfer to the lander for the descent to the surface.

But Russia cannot yet place that much payload in orbit in two launches — its most powerful rocket, the Angara-A5, which made its first test launch in December, can carry about 25 tons — and making several smaller deliveries is considered too complex and risky, according to the FKP-2025 document. Roscosmos’ budget request would not permit development of a launch vehicle powerful enough for the mission before 2030, such as the proposed Energia-5KV, which would carry payloads of at least 70 tons. Financial constraints have also hampered development of a manned

lunar lander.

But if stepping foot on the moon before 2030 is out of the question, experts at the Moscow-based Space Research Institute, known as IKI, and NPO Lavochkin, the nation’s prime developer of planetary probes, devised a plan that might be the next best thing. They want to place a manned spacecraft and an unmanned tanker in lunar orbit, where they would rendezvous with a reusable robotic lander that would be launched separately. The lander, dubbed Korvet, would refuel from the tanker and then descend to the lunar surface to gather soil samples. The Korvet would make up to five trips between the moon and the orbiting crew. The cosmonauts would finally return to Earth with samples from multiple locations.

In November, Lev Zeleny, the head of IKI, told the Tass news agency that the Korvet concept had been included in FKP-2025.

### New space station

Closer to home, and before any lunar mission, Roscosmos sees another gap to fill: The projected retirement of the International Space Station in the mid-2020s could leave cosmonauts without a destination in low-Earth orbit.

Over the years, Russian engineers have considered plans to build a smaller, cheaper successor to the space station, possibly even recycling the newest pieces of the existing Russian segment. These plans have received a new impetus in FKP-2025. Beginning in 2018, Roscosmos wants to start providing seed money for the development of next-generation orbital modules, including a laboratory, an inflatable habitat, a power-supply module and an orbital assembly dock. The modules would be con-

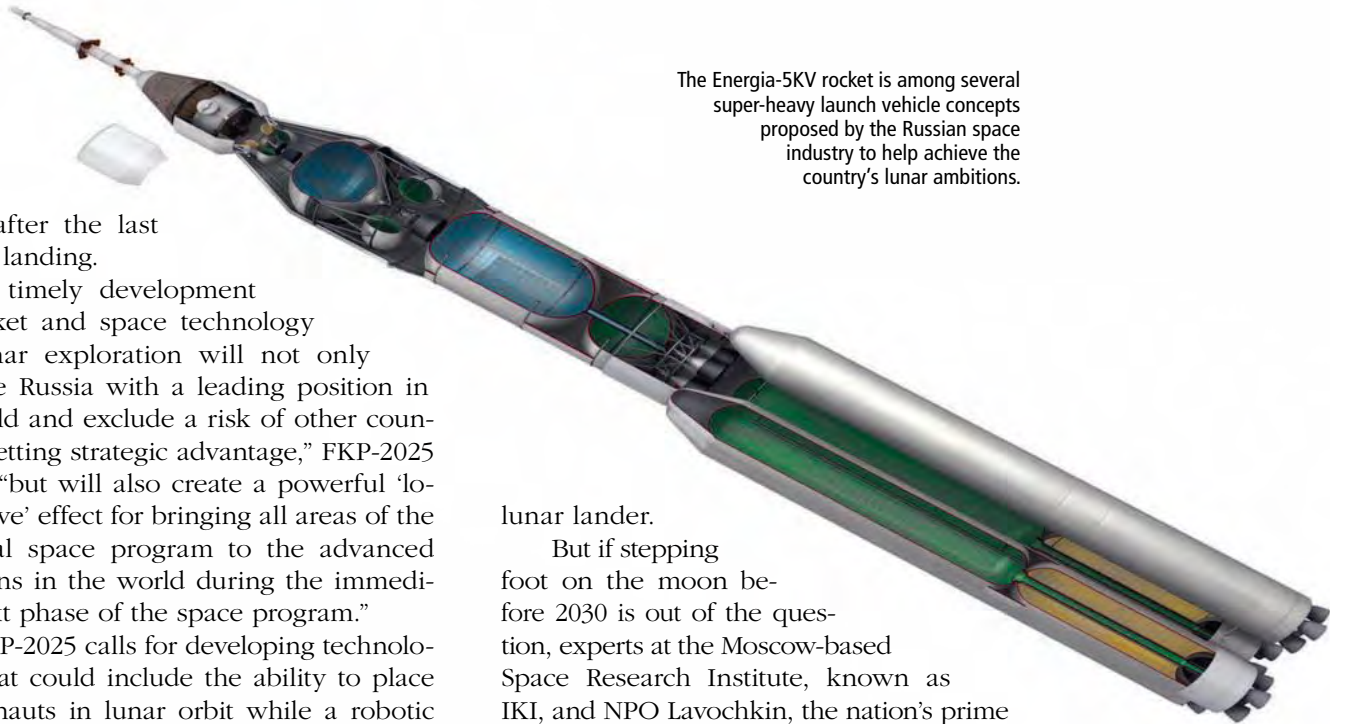
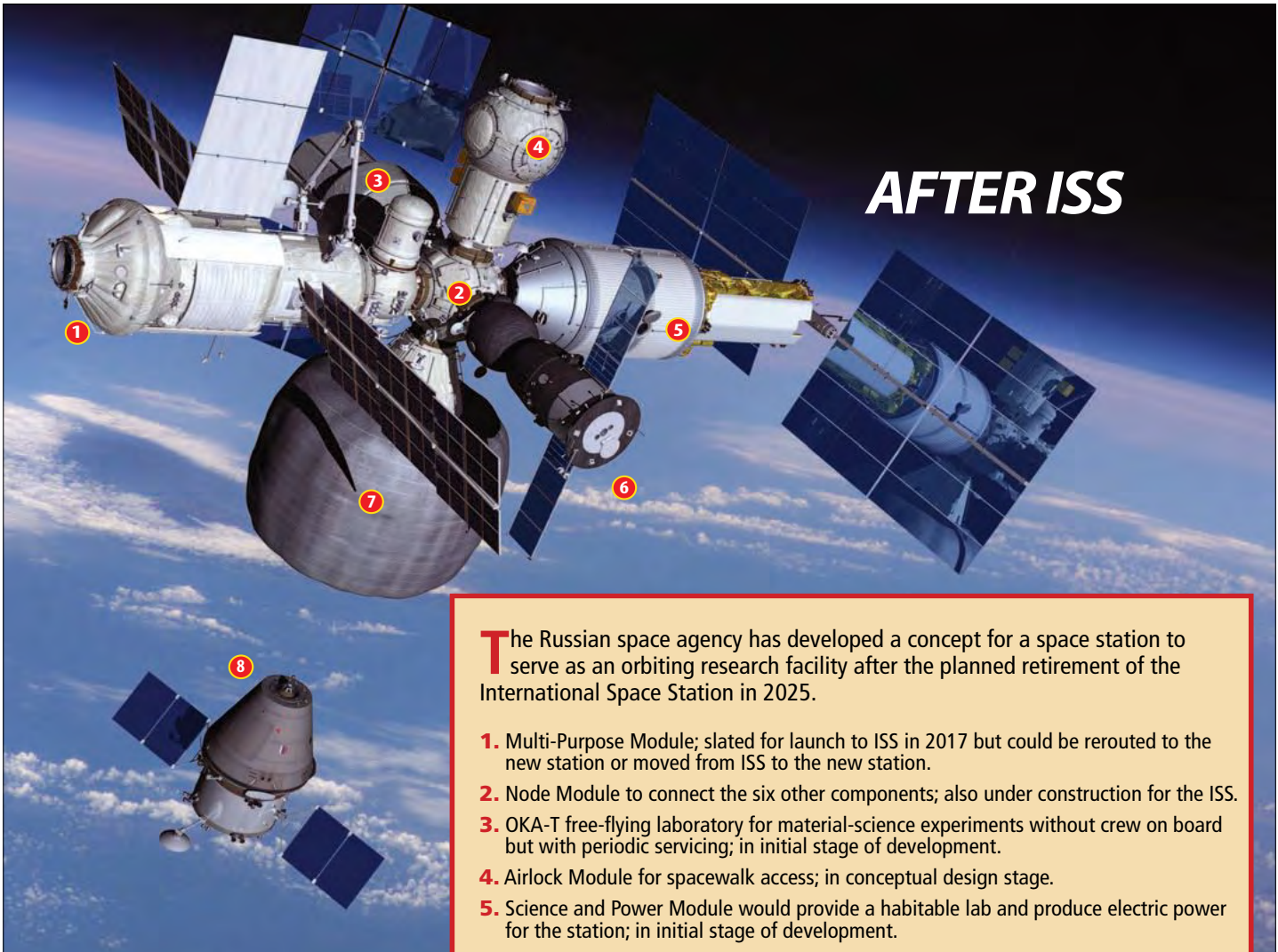


Illustration by Anatoly Zak



## AFTER ISS

**T**he Russian space agency has developed a concept for a space station to serve as an orbiting research facility after the planned retirement of the International Space Station in 2025.

1. Multi-Purpose Module; slated for launch to ISS in 2017 but could be rerouted to the new station or moved from ISS to the new station.
2. Node Module to connect the six other components; also under construction for the ISS.
3. OKA-T free-flying laboratory for material-science experiments without crew on board but with periodic servicing; in initial stage of development.
4. Airlock Module for spacewalk access; in conceptual design stage.
5. Science and Power Module would provide a habitable lab and produce electric power for the station; in initial stage of development.
6. Soyuz transport vehicle.
7. Inflatable habitat; in initial stage of development.
8. PTK NP new-generation piloted transport ship; in development.

Source: Aerospace America research

Illustration by Anatoly Zak

nected, allowing crews to move among them in a shirt-sleeve environment, while the exterior of the outpost could be complemented with robotic arms.

Unlike the massive 20-ton components Russia supplied for the nascent ISS, most modules of a future Russian station would weigh about eight tons to fit in the medium-class Soyuz rockets based at the soon-to-be-completed launch site in Vostochny. The proposed station, which would make extensive use of off-the-shelf hardware to reduce costs, could be launched into a high-inclination orbit to provide better coverage of the Russian territory than is currently possible from the ISS.

“This project has very good prospects,” Ostapenko said at a Dec. 15 press conference. “It will allow us to watch more than 90 percent of the Russian territory and, in the future, use it as a way station to the moon and into deep space.”

### Oil and politics

To achieve its ambitions above the Earth, Russia must rely on what lies beneath it. Oil and gas sales accounted for more than half of Russia’s federal budget revenues in 2012, according to the U.S. Energy Information Administration. Even before the political and economic turmoil of 2014, including declining oil prices, the Russian economy had started moving from surplus

to deficit, primarily under the weight of ever-growing social welfare programs, according to Moshe Yanovskiy of the Gaidar Institute for Economic Policy in Moscow. In December, the Russian Ministry of Economic Development reversed its forecast of slight economic growth of 1.2 percent in 2015 to a decline of 0.8 percent, heralding the beginning of the recession.

In addition, the Kremlin's "suppression of political opposition and heavy-handed involvement into business created a negative climate for future investments" in the Russian economy, Yanovskiy says.

It has also become more difficult for the government to attract the expertise it needs. During the past two decades, the traditional destinations for Russian high-tech workers – the nuclear industry and the military-industrial complex, including space activities – have been competing with domestic and foreign businesses for young talent, Yanovskiy says.

According to estimates by Russia's own statistics agency, Rosstat, 186,382 people

left the country in 2013.

"We are losing the most educated, most active, most entrepreneurial people," Lev Gudkov, director of the independent Levada Center research organization in Moscow, told Reuters.

Even if it can attract the necessary engineering talent, Roscosmos will have to join a long line of candidates for limited federal funds, while its lunar exploration proposals are criticized as too extravagant by skeptics.

"It is difficult to imagine that any government would be ready to spend trillions on the construction of lunar bases, especially when it has many other more important tasks," Andrey Ionin of the Russian Cosmonautics Academy told the Russian daily Izvestiya.

To some people in Russia, the way the nation's grand plans for space have clashed with economic reality might bring to mind an expression popularized by former Prime Minister Viktor Chernomyrdin: "We wanted the best, but it turned out as always." ▲

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