

Collateral Damage

*Impacts of Russia-Ukrainian conflict
extend beyond the here and now*

ANALYSIS
by Anatoly Zak

Russian Vice Prime-Minister Dmitry Rogozin created a stir in April by Tweeting in Russian that astronauts might need to use a trampoline to get to the International Space Station. In the U.S., most analysis of the potential fallout from the Ukrainian crisis has focused on NASA's dependence on Russian Soyuz capsules to deliver astronauts to the station, or on the Russian-supplied engines that help propel the Atlas 5 and Antares rockets. The reality is that so far the Ukraine crisis has not had any real-world impacts in those areas.

Underappreciated is the impact on a slew of lesser-known joint space projects:

Human spaceflight

In October, before the Ukraine crisis boiled over, Russian space officials held a closed-door strategy meeting. Manned spaceflight chief Aleksei Krasnov promised to strike a deal with station partners in two or three years on joint manned missions beyond Earth orbit, according to a transcript. An international manned outpost was discussed that would be deployed in one of the Lagrange points, where gravitational fields of the Earth and the moon cancel each other out. A facility at the L2 Lagrange point behind the moon would be a most convenient way station for exploration. According to Krasnov, this program could eventually afford annual or biannual expeditions to the moon, flights to asteroids and even expeditions to Mars.

In one view, all these ambitious dreams went out of the window when Russia annexed Crimea in September. Even if

Moscow does not deliver on its threat to leave NASA with a trampoline to reach the station, the talk of a new Cold War could ruin the appetite for future cooperation on both sides. Some Russia watchers expect Vladimir Putin to remain in power for life, raising the possibility that renewed Russian-American ties in space might have to wait for at least a generation.

Others still hope that the station partners can weather the storm. A former official from the International Space Exploration Coordination Group, which was created by 14 space agencies to chart joint plans in space, said that Russia and the West would have no choice but to cooperate with each other. He said any major post-station agreement on human missions beyond the Earth's orbit is likely five or six years off. The latest efforts by the station partners to certify the outpost to operate in orbit as late as 2028 could buy time for tensions over the Ukraine to be resolved.

In the meantime, the U.S. is working on the Orion crew spacecraft and the Space Launch System that would send Orion into deep space. NASA would be independent again in its ability to carry astronauts into space. Under a strategy adopted by the U.S. long before the Ukrainian crisis, any cooperation between the U.S. and Russia must be of a complementary rather than dependent nature. NASA would avoid Russian hardware in the critical path to the program's ultimate goal.

Russia's own next-generation spacecraft for flying cosmonauts beyond Earth

NASA



Artist's rendering of the U.S. Space Launch System. Its completion would put NASA back in the astronaut-launching business.



Artist's concept of a manned outpost at the L2 Lagrange point. Author Anatoly Zak says the international partnerships envisioned to make such projects affordable are now threatened by the Russian-Ukrainian crisis.

Boeing

orbit is now several years behind the American effort, suggesting there could be a role reversal by the end of the decade.

Russian-Ukrainian super heavy launcher

Multi-national or not, any major expansion of the manned space program into deep space would require the development of a super-heavy launcher capable of sending a manned spacecraft beyond Earth orbit. In the U.S., the problem is being addressed with the Space Launch System, which is to be capable of delivering 85 tons into low Earth orbit. Such a payload mass would be enough to send a six-seat Orion spacecraft toward the moon or to the Lagrange points.

Roskosmos promised to build its own super-heavy rocket, soliciting bids from its domestic industry for the most suitable design. This ambitious proposal had attracted the interest of the Ukrainian space industry.

In August 2013, Ukraine's main space firm — KB Yuzhnoe design bureau, the developer of the Zenit rocket and the first stage of the U.S. Antares launcher — went to the Moscow Air and Space Show with a scale model of a super-heavy rocket. The Ukrainian bid had powerful supporters in Russia, including the nation's chief manned spacecraft contractor, RKK Energia. The first stages of the super rocket would be built at KB Yuzhnoe's huge rocket factory in Dnepropetrovsk in Eastern Ukraine. Russian authorities had been skeptical about letting Ukraine participate in the super-heavy rocket project, but by the end of 2013, the prospects of Ukraine turning to the European Union for an economic agreement

prompted Russia to act. The Kremlin offered Kiev an alternative, which included space cooperation. An agreement was inked by the two sides in January 2014 guaranteeing Ukraine a role in the development of the Russian super-heavy launcher, Valery Mutiyany, the Ukrainian envoy to Russia told a business publication, *Birzhevoi Lider*.

Just weeks later, the Russian-Ukrainian economic ties collapsed with the overthrow of the Ukrainian President Viktor Yanukovich and the subsequent Russian annexation of Crimea.

End of the Zenit rocket?

The crisis threatens current launch systems operated by two countries, first of all the Zenit. Ukraine has supplied the Zenit for the Russian federal space program and for the struggling Sea Launch venture, which uses a converted oil platform deployed in the Pacific Ocean near the Equator to launch commercial satellites. The crisis in Ukraine could be the last nail in the Zenit's coffin. In July, the head of the Kazakh space agency, Talgat Musabaev, told the Interfax-AVN news agency that plans for launching commercial missions on Zenit from Baikonur had to be scrapped.

In the meantime, KB Yuzhnoe's factory struggled to come up with cash to pay its subcontractors in Russia who supplied components for the Zenit. In a telephone interview, a representative of the Yuzhnoe production association, Anatoly Karmanov, denied reports in the Moscow-based *Izvestiya* daily that the work at the plant had been tak-

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ing place only two days a week. However, Karmanov would not comment about the possible demise of the Zenit.

About 50 percent of all components for the Zenit were coming from Russia, and without Russian orders the Zenit had no chance to survive, deputy director of the National Space Agency of Ukraine, NKAU, Eduard Kuznetsov, told me.

The end of Zenit would be a huge loss for both sides. It would spell the end of the Russian-controlled Sea Launch venture, while the Moscow-based NPO Energomash would lose the only customer for its most powerful rocket engine, the RD-171, which propels the Zenit's first stage.

Not surprisingly, some Russian officials called for building the new production line for the Zenit inside Russia and transferring the Sea Launch floating platform from its current homeport in Long Beach, Calif., to Russia's Pacific coast. Skeptics said that the cost of such moves would kill any commercial viability of the Sea Launch for years to come.

Turning to Europe

The departure of the Zenit from Ukraine would leave KB Yuzhnoe's production arm to build the first stage of the Antares, which is based on the Zenit but uses a different Russian-built engine. In addition, KB Yuzhnoe builds the RD-869 engine for the fourth stage of the European Vega rocket introduced in 2012 for launching small satellites. By the middle of this year, the Ukrainian company had delivered four of these engines to the Vega's prime contractor — Avio of Rome, Italy. At the time of the Crimean showdown, two more propulsion systems for Vega were in production in Ukraine and a contract for up to a total of 16 units was in the works, industry sources said.

In 2012, the European Space Agency adopted a strategy of phasing out the Ukrainian hardware and replacing it with a domestically built system, even though the Vega would still need Ukrainian engines as late as 2020.

"We are trying to retain this position and maybe even expand [our participation in the Vega project] by proposing something else for this vehicle," NKAU's Kuznetsov said. According to Kuznetsov, KB Yuzhnoe was working on new lightweight composite materials, which could replace traditional alloys in the Vega's components.

Ukrainian involvement in European space projects has been hampered by the country's failed bid to join the European Space Agency. The cash-strapped Ukrainian government was

not able to pony up its required entrance fee, estimated at around €5 million. Now, a breakup with Russia is providing fresh impetus for Ukraine's economy to link up with Europe's.

"Today, NKAU is ready to join ESA at least as an associated member," Kuznetsov said, adding that such an agreement could be signed in 2015 if ESA were to provide a discount.

In the meantime, KB Yuzhnoe is actively looking for new customers in the aerospace industry around the world who could fill the void left by the Russian-Ukrainian split.

Russian ICBMs

An irony of the conflict between Russia and Ukraine is that experts from Ukraine still conduct periodic maintenance of Russia's nuclear-armed SS-18 ICBMs. These rockets were built at KB Yuzhnoe's factory in Dnepropetrovsk. In the post-Soviet period, 20 such boosters were converted into Dnepr space launchers and fired with a peaceful mission to deliver commercial satellites into orbit. The joint Russian-Ukrainian team launched the latest Dnepr rocket on June 19, in the midst of the crisis, even though three days earlier the newly elected Ukrainian president, Petr Poroshenko, had ordered an end to all military cooperation between Ukraine and Russia. Still, as of July, NKAU had not received any instructions to discontinue servicing work on the Russian ICBMs, Kuznetsov told Aerospace America.

The Zenit and Dnepr are the product of deep ties between the Russian and Ukrainian industries, and cutting those ties would have enormous economic impact. According to the Kommersant daily, Roskosmos estimated the price tag for breaking up with Ukraine at 3.5 billion rubles — \$96.6 million — just this year, and at 33 billion rubles — \$911 million — by 2018. The agency's proposal for replacing Ukrainian-made components currently in use across the Russian space and rocket industry listed 56 different items, including electronics and chemicals.

Other fallout from the Ukrainian crisis

The annexation of Crimea by Russia left Ukraine without a major ground control station on the peninsula, requiring a new facility — currently under construction — on mainland Ukraine. The loss of the Crimean ground station also contributed to the grounding of Lybid, the Ukrainian communications satellite, built in Russia and slated to launch on a Zenit. ▲

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The Zenit rocket, long used for launches by Russia, is built by KB Yuzhnoe in Ukraine. Tensions between the two countries could lead to the rocket's demise.