



# The Changing Role of Russia in Space

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# EXECUTIVE SUMMARY

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Russia has long been recognized as a leader in global space activity. Its past accomplishments and current capabilities in human spaceflight and space science play an important role in Russian national identity and its perception as a great power globally.<sup>1</sup> Its launch systems, communications, remote sensing, navigation, and early-warning satellites provide important capabilities for economic and military activity. However, the war in Ukraine has damaged long-standing international partnerships in space and put significant strain on the Russian space program across civil, commercial, and military sectors. This paper examines these impacts and their implications for the future of Russia's space activity.

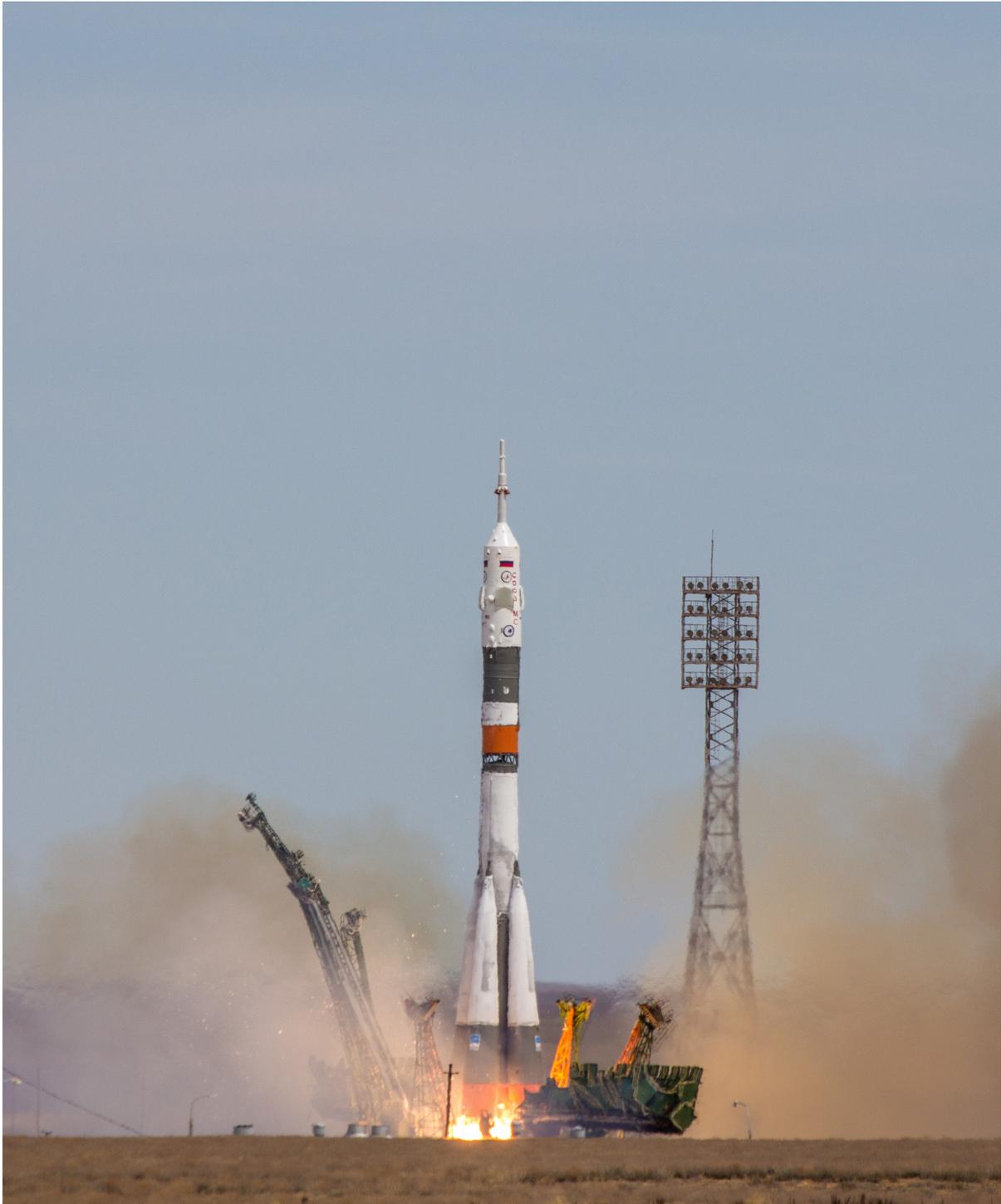
International partnerships in space programs were the target of adversarial rhetoric and upheaval in the earliest days of the 2022 war. Europe ended participation with Russia on multiple high-profile space science programs, including ExoMars, a joint Mars program that after nearly a decade of development, was only months away from launch. European participation in lunar programs and astronomy also ended abruptly, leaving both Europe and Russia with gaps in their mission capabilities. In the realm of human exploration, Russia threatened to withdraw from the International Space Station (ISS) on multiple occasions. However, with no practical alternative for its human spaceflight program in the near term, Russia ultimately adopted a more conciliatory tone, and suggested it was likely to extend, not end, its participation in the ISS.

In response to sanctions, Russia halted launches of its Soyuz rocket from French Guiana, leaving

many European and other missions stranded on Earth. Nearly all foreign customers that had contracted for launches by Russia canceled these plans. This has led to a drastic reduction in Russia's share of the global launch market that is unlikely to be regained in the future. Similarly, Russia halted sales of rocket engines to the U.S., hastening an existing trend toward the development of fully-domestic launchers in the United States and a significant loss of revenue for Russia's Energomash rocket company. Sanctions have also impacted Russia's imports of space-relevant technologies, resulting in continued efforts by Russia to develop domestic import-substitution capabilities, and slowing Russia's development of advanced space technologies.

Russia has made significant investments in counterspace technologies and has demonstrated in Ukraine that it is willing to use jamming, spoofing, and cyberattacks against space systems. Its 2021 destructive anti-satellite test, along with provocative statements, have raised questions about Russia's willingness to engage in more damaging attacks on both national and commercial space assets. Despite this, Russia has remained active in international forums, including the United Nations Open-Ended Working Group on Reducing Space Threats, potentially providing a venue for engagement and the reduction of tensions in this domain.

The war in Ukraine is likely to result in significantly reduced civil and commercial Russian space capabilities. With financial difficulties limiting national investment, Russia may pivot to greater cooperation with China, or it may emphasize



investments in military and counterspace capabilities in an attempt to retain its image as a leader in global space activity. NATO countries must determine whether and how to engage with Russia in the civil realm while limiting future

dependence on Russia. Allies should continue to work with Russia within the United Nations system on efforts to reduce space threats, particularly during this time of high tensions.

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# INTRODUCTION

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Russia traces its leadership in space to the Soviet launch of the first satellite, marking the beginning of the space age. Even after the space race of the 1960s concluded, the Soviet Union continued to develop advanced space capabilities, leading in the development of human space stations, and contributing to global capabilities for weather monitoring, communications, and navigation. These experiences solidified space as a key element of Russia's national identity.<sup>2</sup>

Russia has maintained its role as a great space power in modern times. In 2021, Russia conducted the third most space launches in the world, behind the United States and China, and maintained the third most operational objects in space (also behind the United States and China).<sup>3</sup> Space assets also play a key role in Russian national security. In April 2021, Russian President Vladimir Putin stated, "Russia must maintain its status as a leading nuclear and space power because the space industry is directly linked to defense," and called space a "truly strategic area."<sup>4</sup>

Russia's invasion of Ukraine in February 2022 further highlighted the importance of space assets. Commercial space companies in the West detected and reported on the massing of Russian troops and GPS-jamming at the Ukrainian border.<sup>5</sup> Russia carried out a cyberattack against the Viasat communications network, resulting in degraded communications for the Ukrainian military, as well as negative impacts on a range of other customers in Europe.<sup>6</sup> As the war has progressed, data from remote sensing satellites and connectivity provided by the SpaceX Starlink communications network have proven critical to Ukrainian military activities,

prompting Russia to state that such systems may be a "legitimate target for military attack."<sup>7</sup> The war has resulted in the abandonment of multiple cooperative space projects and has had significant impacts on the Russian space launch market.

This paper investigates these impacts, examining how the war in Ukraine has affected Russia's space program and what the long-term implications of these effects may be. After providing a brief overview of Russia's space program prior to the war, the paper examines a range of issues, including international cooperation on human exploration and space science, the global commercial launch market, Russian space exports and imports, counterspace technologies, and diplomatic engagement. The paper concludes with a discussion of potential future directions for Russia's space program, as well as recommendations for NATO.

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# RUSSIA'S SPACE PROGRAM BEFORE THE WAR IN UKRAINE

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As a global superpower, the Soviet Union's capabilities were on full display during the Cold War. The Soviet program was the first to launch a satellite, the first to put a human in space, and the first to conduct in-orbit rendezvous and docking. Although it did not succeed in placing a human on the Moon, the Soviet Union took the lead in the development of human space stations. Beginning in 1975, the Soviet Union engaged with the United States in a series of cooperative efforts in space, using this unique domain as a venue for cooperation and peaceful engagement. The Soviet Union's dramatic accomplishments in space solidified the importance of space leadership as part of Soviet, and later Russian, national identity.<sup>8</sup>

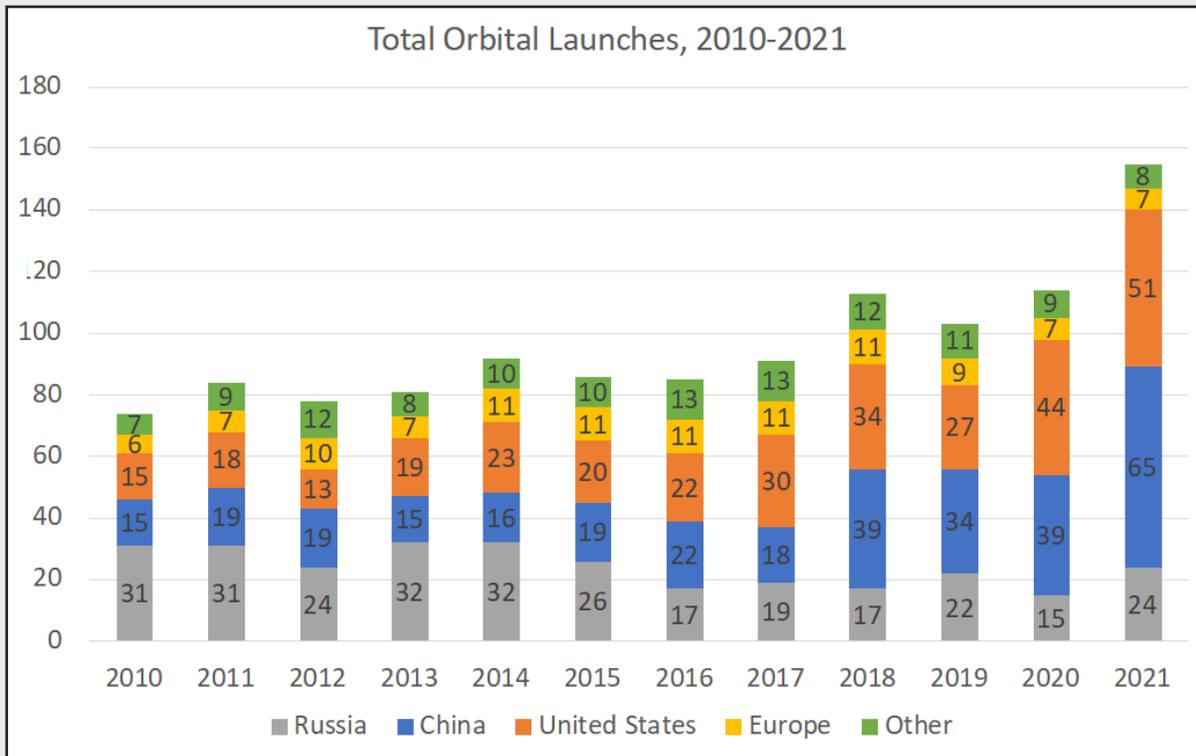
After the break-up of the Soviet Union, the Russian space program faced significant challenges due to a lack of resources and fracturing of its space infrastructure, which was located in a variety of independent states.<sup>9</sup> While its proven launch technology allowed it to gain a role in the emerging global commercial launch sector, its civil and military space capabilities degraded over time as systems, such as the Global Navigation Satellite System (GLONASS) navigation satellite constellation, were not maintained.

International partnerships proved key to Russia's space program during this time. In 1992, Russia was invited to join the International Space Station project. Under this agreement, the United States provided Russia funding in return for Russian contributions to the project, providing an infusion of resources that helped maintain Russia's program and ensured Russian rocket scientists remained engaged on peaceful space programs, stemming the potential proliferation of missile

technology and expertise outside of Russia.<sup>10</sup> It was also during this period that the U.S. defense contractor, Lockheed Martin, began contracting with Russian engine-maker NPO Energomash to purchase RD-180 engines for the Atlas V launch vehicle.<sup>11</sup> Around the same time, the French launch company, Arianespace, reached an agreement to market and operate Russian Soyuz rockets.<sup>12</sup>

When Vladimir Putin came to power in 1999, he made space a strategic priority. In the early 2000s, Russia restored the GLONASS navigation system and other space applications capabilities, improved launch infrastructure, and re-invested in counterspace capabilities. The Russian space budget grew significantly during this period.<sup>13</sup> In 2013, Russia was responsible for more than half of all global commercial launches<sup>14</sup>, and in 2014, Russia conducted more launches than any other nation.<sup>15</sup> Russia was also active in international forums, including proposing the Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects (PPWT) in the United Nations Conference on Disarmament.

Following the retirement of the Space Shuttle in 2011, Russia became the sole provider of human transportation services to the International Space Station and steadily increased the prices charged to NASA, further increasing resources for the Russian program.<sup>16</sup> Russia also prioritized partnerships with Western nations to rebuild its space science program. The European Space Agency (ESA) was named as a partner in Russia's revitalized Luna moon missions, with plans to contribute to the first three systems. Russia and ESA also partnered on the two-spacecraft ExoMars mission, and



Source: *The Space Report*, Space Foundation

Russia and NASA began talks about potential collaboration on a Venus mission. Russia worked with Germany to develop the SPEKTR-RG x-ray telescope, focused on advancing astrophysics.<sup>17</sup>

A number of factors contributed to the reversal of this trend in the second half of the 2010s. Following the Russian invasion of Crimea in 2014, the United States, European Union, and others put in place sanctions that damaged the Russian economy and limited Russia’s ability to import space components. The collapse of the ruble further added to Russia’s economic challenges. The budget for the Russian space program for 2016 to 2025 was cut from the original request of \$70 billion to just \$20 billion.<sup>18</sup> These challenges, along with a string of launch failures due to quality control issues, led one expert to state in 2015 that Russia’s space program was “in a state of crisis.”<sup>19</sup>

During this same period, the U.S. launch company, SpaceX, was ramping up its capabilities, creating significant competition for Russian launch services. After making up an average of 40% of global commercial launches from 2010 to 2014, from 2015 to 2021, Russia accounted for about

11% of global commercial launches, on average.<sup>20</sup> There were indications that further reductions may be imminent. Arianespace, which had been marketing Soyuz launches from its French Guiana launch site for over a decade, announced in January 2022 that it may no longer market Soyuz launches after 2023 due to the introduction of the new European-built Vega C and Ariane 6 rockets.<sup>21</sup>

Russia also lost a significant source of revenue when SpaceX began launching humans to the International Space Station in 2020, as NASA no longer needed to pay Russia for transportation services.<sup>22</sup> Tensions following the Annexation of Crimea also led the U.S. Congress to place a limit on the number of RD-180 engines that could be purchased from Russia and mandated the development of a new U.S. national security launch system that would not rely on Russian engines.<sup>23</sup>

While civil space budgets in Russia declined, the country increased its focus on military space activity. In 2015, Russia reorganized its armed forces to create a new branch of the Aerospace Defense Forces focused on space.<sup>24</sup> In 2015, the



Russian Luch satellite made a series of orbital maneuvers in the Geostationary belt, including close approaches to commercial and military satellites owned by the United States, Europe, France, and others.<sup>25</sup> In 2019, a Russian “inspector” satellite approached an American spy satellite and released a projectile, leading the United States to identify it as an anti-satellite weapon.<sup>26</sup> In 2021, Russia carried out a destructive kinetic anti-satellite weapon test, creating more than 1,500 pieces of debris.<sup>27</sup>

While space cooperation with the United States and Europe on the International Space Station and space science continued largely unaffected,

Russia began to emphasize national projects and increase its engagement with China and other nations in space. In 2021, Russia announced it would end its participation in the ISS in 2024, with plans to launch a national space station as a replacement.<sup>28</sup> Russia engaged with China on programs to integrate the Russian GLONASS and Chinese Beidou navigation systems and agreed to assist China in the development of a missile warning system.<sup>29</sup> After considering participation in the U.S.-led Lunar Gateway project, Russia ultimately rejected this possibility, calling the project “too U.S.-centric.”<sup>30</sup> Instead, Russia announced plans to partner with China to build a joint International Lunar Research Station.<sup>31</sup>

In addition to its engagement with China, Russia worked to build partnerships with emerging space nations. These partnerships allow Russia to leverage its expertise in the space sector to increase its influence in these regions. These efforts can serve broader foreign policy goals and potentially bring some resources to the Russian space program. In 2020, India sent the individuals selected for its future human space program for training in Russia.<sup>32</sup> In December 2021, India and Russia agreed to strengthen cooperation in the space sector, building on existing cooperation in human spaceflight and satellite navigation and extending to areas such as launch vehicles and planetary exploration.<sup>33</sup> Russia also explored opportunities for cooperation in space with other nations in Asia, including Pakistan, Thailand, Indonesia, and Malaysia.<sup>34</sup> Outside of Asia, Russia has pursued space-related agreements with Brazil, Venezuela, Mexico, Argentina, Ecuador, South Africa, and others.<sup>35</sup>

Russia has also engaged numerous nations in the Middle East and North Africa, where interest in space activity is rapidly increasing. In 2019, Russia launched the first astronaut from the United Arab Emirates (UAE) to the International Space Station, and in 2021, the two nations signed an agreement to pursue further cooperation in outer space.<sup>36</sup> Russia also announced plans to train cosmonauts

from Saudi Arabia and Tunisia in preparation for human missions to space on Russian vehicles.<sup>37</sup> A delegation of officials from Russian space organizations, including Roscosmos, visited Algeria in 2019 to discuss expanding space cooperation.<sup>38</sup> Roscosmos reported in 2021 that it was in discussions with Egypt about increasing cooperation in space, and that a framework agreement had been drafted.<sup>39</sup>

Leveraging its partnerships with major space nations and its expertise in the space sector, Russia has remained a great power in space. However, by 2021, many space experts had noted the downward trends affecting its space industry. Clay Moltz, professor at the U.S. Naval Postgraduate School, wrote in 2020 that the Russian space program seemed to be in “a slow but steady decline,” and stated, “it is hard to see how Russia can expect to restore its previously leading role in international space activity.”<sup>40</sup> Florian Vidal, a research fellow at the French Institute of International Relations, described Russia’s space program in 2021 as “a sector threatened by decline.”<sup>41</sup> It is in this context that the war in Ukraine occurred, accelerating many of the trends already in progress.



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# INTERNATIONAL COOPERATION IN HUMAN EXPLORATION AND SPACE SCIENCE

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While international cooperation in space was able to survive Russian engagements in Georgia in 2008, the annexation of Crimea in 2014, and conflict in Syria in 2020, the 2022 war in Ukraine proved to be a breaking point for many programs. This was particularly apparent in the area of space science, where nearly every major international cooperative effort between Russia and the West was canceled.

## Space Science

Perhaps the most dramatic of these was the ExoMars mission, which, after nearly a decade of development, was only a few months away from being launched. Although ESA leaders initially held out hope that civil space cooperation “remains a bridge” between nations<sup>42</sup>, the agency ultimately made the decision to end cooperation with Russia on the project.<sup>43</sup> Having already developed the Rosalind Franklin Mars rover, European nations decided to provide additional funding to develop many components of the landing platform Russia was originally to provide, and it will rely on NASA to provide additional elements, including the launch.<sup>44</sup>

Europe also announced that it would end cooperation on a series of lunar missions that had been planned with Russia. ESA requested that the experimental navigation camera be removed from the Luna-25 spacecraft, which had originally been planned for launch in 2022, and returned to the agency. Another instrument under development for the Luna-27 mission will instead be flown with a NASA Commercial Lunar Payload

System lander.<sup>45</sup> The Russian-German Spektr-RG x-ray observatory launched in 2019, but after the invasion of Ukraine, Germany placed the primary instrument, the German-built eROSITA telescope, into a safe mode, halting operations.<sup>46</sup> Russia announced that it would no longer include the United States in development of the Venera-D Venus mission.<sup>47</sup>

## International Space Station

The most high-profile interactions on space cooperation involved Russia’s participation with the International Space Station (ISS). Although the station does have a Russian segment and a U.S. segment, the system is fully integrated and interdependent, with the U.S. segment providing power and the Russian segment providing the propulsion needed to maintain the correct orbit. After sanctions were imposed by the United States, Europe, and others in response to the invasion of Ukraine, the head of the Russian space program, Dmitry Rogozin, took to Twitter, asking: “If you block cooperation with us, who will save the ISS from an uncontrolled deorbit and fall into the United States or Europe?”<sup>48</sup>

Despite this rhetoric, NASA officials provided reassurance that day-to-day operations on the ISS had not been affected by the war in Ukraine. In late March, a NASA astronaut returned to Earth in a Russian Soyuz spacecraft, landing in Kazakhstan before returning to the United States.<sup>49</sup> In early April, Rogozin reiterated that unless sanctions on the country were removed, Russia would leave the ISS.<sup>50</sup> Later that month, he stated that the



decision to leave the ISS had been made, although he noted Russia would provide at least one year advance notice to the ISS partners.<sup>51</sup>

In mid-July 2022, the bombastic Rogozin was replaced by Yuri Borisov as head of the Russian Space Agency in a move that heralded a pivot to a more conciliatory tone.<sup>52</sup> While Borisov initially confirmed that Russia planned to leave the ISS “after 2024”<sup>53</sup>, he later clarified that this announcement meant Russia would leave no earlier than 2024, and would likely continue its engagement in the ISS program until 2028.<sup>54</sup> Shortly after Borisov took over, NASA and Roscosmos officially agreed to exchange four seats on missions to the ISS: in September, a NASA astronaut launched on a Soyuz spacecraft, and in October, a Russian cosmonaut rode on the SpaceX Crew-5 mission. Speaking at a briefing after the SpaceX launch, the Roscosmos director of human spaceflight, Sergei Krikalev, drew a link between cooperation that had begun in 1975 with the Apollo-Soyuz project and the new phase of cooperation occurring now. When asked whether his comments were part of an effort to improve relations with NASA that had been strained by Rogozin, Krikalev replied, “the answer is yes.”<sup>55</sup>

#### *Implications for Russia’s Space Program*

Prior to the War in Ukraine, multiple experts had suggested that Russia’s high-profile international cooperative space missions were key to generating national prestige and retaining Russia’s status as a great space power.<sup>56</sup> If Russia wishes to maintain its place as a leader in global space activity, it has three options: independently develop high-profile national spaceflight programs, pivot to partnership with China, or rebuild relationships with the United States and Europe. Russia may also continue to engage in partnerships with smaller or emerging space powers, but these activities on their own would represent a reduced scope of activity and exclusion from leading international endeavors. If Russia engages in only these types of partnerships, this would risk placing Russia as a second-tier space power.

Since 2014, Russia has announced multiple goals aligned with the first option, including the development of a Russian Orbital Service Station (ROSS), planned to begin in-orbit construction in 2028.<sup>57</sup> Krikalev has stated that Russia’s intention is to continue to participate in the ISS until the station is built. However, given that work



on the station is in its earliest phases, the target date seems highly optimistic. This suggests that national programs alone are not a feasible solution for human spaceflight in the near-term. Similarly, while Russia still plans to pursue its planetary exploration programs, the long-delayed Luna and Venera programs are likely to experience additional set-backs from the loss of key European instruments. In addition, unlike Europe, it seems unlikely that Russia will be able to secure sufficient funds to make use of its portion of the ExoMars mission without Europe's contribution.

As noted above, Russia had already begun to engage in greater cooperation with China. The two nations have signed a series of agreements related to space application technologies and announced plans for a joint International Lunar Research Station. Significant Russo-Chinese cooperation in space could exacerbate perceptions of a two-bloc

environment and a divide between allied nations and strategic competitors. This could lead to a more adversarial environment for space exploration and development with fewer opportunities for peaceful engagement and cooperation.

However, there are some indications that China is downplaying Russia's role in the effort. Although the concept was originally presented as a project between equal partners in 2021, a Chinese presentation at an event in September 2022 referred to it as an "ongoing program of international major scientific project in China," with no explicit mention of Russia.<sup>58</sup> Some have suggested that given its reduced budget and aging workforce, combined with the geopolitical tensions caused by the War in Ukraine, China may no longer see Russia as a valuable partner. Continuing or even expanding partnership with China is a viable option for Russia only if China

is willing to engage Russia as an equal – an open question moving forward.

Finally, Russia could attempt to rebuild relationships with the United States and Europe. There are some indications that this is already occurring, as evidenced by the removal of Rogozin and the comments of Krikalev. However, it remains to be seen whether this effort at reengagement will be limited to the ISS, where Russia has already made significant investments, and where the lack of alternative human spaceflight destinations limit its options. Regardless of current intentions, this continued cooperation will keep the door open to rebuilding relationships in the future.

In addition to its engagement with other great powers in space, Russia has made efforts to continue to partner with emerging space powers, and multiple nations have demonstrated a willingness to continue to work with Russia despite the war in Ukraine. In July 2022, the UAE Ambassador to Russia stated, “Russia is an important partner of the Emirates in the field of space exploration,” and noted that they hoped space cooperation between the two countries would grow stronger.<sup>59</sup> Similarly, Tunisia has continued its cooperation with Russia to develop its nascent space program, and Thailand was reportedly developing a bilateral agreement with Russia on space cooperation.<sup>60</sup> Venezuela, Mexico, and South Africa have also continued space cooperation with Russia throughout 2022.<sup>61</sup> Most notable from a security perspective, is Russia’s increased engagement with Iran. Russia developed and launched a high-resolution remote sensing satellite for Iran in August 2022, and in December, the two countries signed a new agreement on cooperation in the space industry that will include joint development of remote sensing and telecommunication satellites, as well as training for Iranian space professionals.<sup>62</sup>

## Commercial Launch

As noted above, Russia became a leader in the global commercial launch market in the first two decades of the 2000s, in part due to partnerships with Europe that allowed Arianespace to market Soyuz launches. Although its market share had begun to decrease with the rapid growth of SpaceX and increased Chinese commercial launches, as of early 2022, Russia continued to provide

a significant portion of global launch capacity, including for U.S. and European customers. However, this connection was severed after the war in Ukraine.

In February 2022, in response to EU sanctions, Russia suspended launches of its Soyuz rocket from Arianespace’s French Guiana launch site and withdrew its personnel from the site. The most immediate impact was on two European Galileo navigation satellites, which had been scheduled for launch in April 2022. Also on the manifest were two additional Galileo satellites planned for launch later in the year, an EU Copernicus satellite, an ESA-JAXA Earth science mission, a European space telescope, and European weather satellites.<sup>63</sup>

Commercial launches in Russia were also affected. In 2015, OneWeb, a satellite communications constellation company, contracted with Arianespace for 21 Soyuz launches, making it the largest commercial rocket buy in history. The \$1+ billion deal was a lifeline for the declining Russian commercial launch market. Then-head of Roscosmos, Igor Komarov, claimed, “the choice of Soyuz is evidence of the high competitiveness of the Russian rocket and space technology.”<sup>64</sup>

The 14th launch under the contract was scheduled to take-off from the Baikonur Cosmodrome on March 4, 2022, and the spacecraft were already integrated into the launcher when the invasion of Ukraine occurred. While it originally seemed that the launch would proceed as planned, on March 2nd, shortly before the rocket was rolled to the launchpad, Rogozin tweeted that the launch would only occur if OneWeb would guarantee the satellites would not be used for military purposes and if the British government would divest its stake in the company.<sup>65</sup> OneWeb refused to concede to the demands, announcing that it would suspend all launches from Baikonur.<sup>66</sup> Russia did not return the satellites, and OneWeb estimated that the loss of property and delays resulted in a loss of \$229 million for the company.<sup>67</sup> Other commercial launches originally planned to take off from Russia included satellites from South Korea, Sweden, and Japan, all of which have sought alternative launch options.<sup>68</sup>

OneWeb was able to contract with SpaceX, Russia’s main competitor in the launch market, as well as with India, to complete the remaining

missions. One Indian newspaper stated simply, “Russian loss now Indian win.”<sup>69</sup> OneWeb also reached a settlement with Arianespace that may allow the original launch services agreement to be revived, with the second-generation OneWeb satellites potentially launching on the Ariane 6 vehicle.<sup>70</sup> Teams for the Swedish satellite and one of the Japanese satellites turned to small launch start-up RocketLab to launch their stranded satellites, with both launches occurring successfully in late 2022.<sup>71</sup>

Other stranded missions face greater delays. After determining it was unlikely to retrieve payments already made to Russia, South Korea secured additional government funding to support the selection of a European or U.S. launcher for its two satellites, but a launch provider had not yet been selected as of January 2023.<sup>72</sup> European missions accounted for more than half of the non-OneWeb Soyuz missions left stranded by the war. Europe has long had a strong preference for contracting with European launchers, but with Ariane 5 about to retire and the first Ariane 6 launch delayed to 2023, it has limited options. Europe chose to contract with SpaceX for launch of the Euclid space telescope, but even with this shift, the launch is delayed until 2023.<sup>73</sup> The Sentinel 1C and EarthCare missions will be launched on a Vega-C rocket in 2023.<sup>74</sup> However, future Vega launches are at risk due to the vehicle’s reliance on Ukrainian-built engines.<sup>75</sup> Launch plans for the stranded Galileo satellites had not been officially announced as of January 2023.

#### *Implications for Russia’s Space Program*

Russia’s decision to halt Soyuz launches in French Guiana and place untenable demands on foreign missions launching within Russia has created short term losses and delays for these customers as they identify alternate launch providers. However, the long-term damage to Russia’s commercial launch market is likely to be much more severe. As noted above, Russia’s competitiveness was already declining as SpaceX and other new launch providers entered the market. This event further hastened the movement of its customers to these other companies.

China, which may be more amenable to working with Russia in general, relies exclusively on its own domestic launch capability, including

emerging commercial options, and is very unlikely to purchase Russian launch services. Following the invasion of Ukraine, the only foreign satellites launched by Russia in 2022 were for Iran and Angola.<sup>76</sup> Without western customers, Russia will not be able to play a meaningful role in the commercial launch market.

Unlike the case of international partnerships on human spaceflight and space science, Russia does not seem to have any viable options to rebuild its commercial launch market. While it has announced plans to develop new launch vehicles, the plans are far behind schedule and unlikely to produce launchers that are cost competitive with existing and upcoming capabilities offered by other nations.<sup>77</sup> Further, its treatment of customers, particularly its confiscation of OneWeb satellites and its refusal to refund payments for launches that have been canceled, have soured former customers and given the country a reputation as an unreliable business partner. It is hard to see how Russia could recover from these conditions to re-attract customers in the future.

This loss will result in long-term decreases in revenue for the Russian space program, further depleting resources from the sector. It will also make it more difficult for Russia to claim ‘great power’ status in space, as its role in global commercial launch decreases and the total number of annual Russian launches falls. As one article in The Washington Post put it, “By destroying collaborations with Europe, Russia has transformed itself into the world’s first former space power.”<sup>78</sup>

#### **Russian Exports: Rocket Engines**

In addition to selling launch services, Russia has for many years sold rocket engines to the United States. The decision to incorporate Russian RD-180 engines into the U.S.-based United Launch Alliance (ULA) Atlas V rocket was made in the 1990s both as part of overall strategic engagement with Russia in space as well as in an effort to take advantage of Russia’s low cost, powerful, and reliable rocket engines.<sup>79</sup> In March 2022, in response to sanctions levied by the United States and others, Russia announced it would stop supplying rocket engines to the United States and would no longer service engines already delivered to the United States.<sup>80</sup>



The impacts of the announcement on the Atlas V were limited, largely because the U.S. had already begun developing plans to shift away from the RD-180 engine in 2014, following the Russian annexation of Crimea. At that time, Rogozin, then Russian Deputy Prime Minister for Defense, had tweeted a threat to ban the sale of the engines

to the United States. Although Russia didn't follow through on this threat (with one Russian military official explaining "it wouldn't be profitable for us to do so,") the U.S. Congress took the initiative and banned future purchases of the engine and mandated the development of a new launch vehicle that would use U.S. engines.<sup>81</sup> In April

2021, Energomash held a ceremony associated with the hand-over of the final six RD-180 engines sold under the 20-year program.<sup>82</sup> In early 2023, the Vulcan launch vehicle, designed to replace the Atlas V, is expected to have its maiden launch.<sup>83</sup>

More significantly impacted was the Northrop Grumman Antares Rocket. In 2015, Orbital Sciences (then owner of the Antares rocket) underwent a redesign to replace its use of refurbished Soviet NK-33 engines with newly developed Russian RD-181 engines. In 2015, the company signed a deal with Energomash to purchase up to 60 RD-181s.<sup>84</sup> When the ban on sales was announced by Russia in 2022, Antares announced that it had enough RD-181s stockpiled to allow the company to complete two planned ISS resupply missions, and the company would then rely on SpaceX for three launches of its Cygnus spacecraft.<sup>85</sup> In August, Northrop announced it had partnered with start-up company Firefly Aerospace to develop a fully-domestic version of the Antares vehicle, which the companies say could be ready as soon as 2024.<sup>86</sup>

#### *Implications for Russia's Space Program*

The war in Ukraine put an end to a 20-year, mutually-beneficial partnership between U.S. and Russian space companies, further unraveling connections built after the fall of the Soviet Union. Once again, Russian actions in this area are likely to cause relatively minimal or short-term impacts on U.S. companies while resulting in longer-term impacts for the Russian space program. The loss of access to Russian engines, which, by all accounts are low cost, reliable, and efficient, is a loss to the U.S. launch companies and their customers, but newly developed U.S. rockets are able to meet launch requirements. The need to re-design launch vehicles to accommodate new U.S.-built engines is costly, but may allow the companies to adopt more modern designs. ULA is less than one year away from launching its new Vulcan rocket, and Northrop Grumman is beginning down a similar path.

However, when the United States decided to stop purchasing RD-180 engines after the 2014 annexation of Crimea, the future of Energomash, one of Russia's internationally known and respected space firms, was put in jeopardy. In 2013, it sold 11 RD-180s, eight of which went

to ULA. A space policy expert at the Russian Academy of Cosmonautics stated that the shift would be "catastrophic for Energomash and quite painful for the Russian space industry." Orbital Science's 2015 decision to purchase RD-181 engines helped to save the company, but with the 2022 decision to halt sales, this revenue stream will be lost as well.<sup>87</sup> Russia has explored selling engines to China, although there is concern that China will eventually gain the capability to develop the technology itself, putting Russia out of business.<sup>88</sup> Ultimately, with few external customers and low domestic demand, the future of Russia's engine production capabilities is uncertain.

## **Sanctions and Space Imports**

When President Biden announced in February 2022 that the United States, along with allies and partners, was imposing sanctions on Russia in response to the invasion of Ukraine, he noted that the sanctions would "degrade their aerospace industry, including their space program."<sup>89</sup> Dmitry Rogozin responded on Twitter, noting that the U.S. had already imposed similar sanctions after the 2014 annexation of Crimea, and that Russia had already responded by expanding the production of components and devices at home.<sup>90</sup> However, Rogozin's tweet belies the challenges that the previous sanctions caused for the Russian space program.

As of 2015, reports suggest that up to 75 percent of electronic parts on Russian satellites came from the United States.<sup>91</sup> Russia's Federal Space Program for 2016-2025 set a goal of "technological independence," which included developing new technology based on domestic components as well as decreasing Russian dependence on foreign space information.<sup>92</sup> However, reconstituting Russian production lines is costly and time-consuming<sup>93</sup>, and the lack of sufficient budgetary support for these efforts has in some cases resulted in Russia using "substandard or ill-fitting" Russian or foreign components from countries that don't adhere to UN sanctions.<sup>94</sup>

In 2019, Vice Premier Yuri Borisov had a serious discussion with top military officials about "delays in the development of domestic satellite constellations servicing Russian military

purposes.<sup>95</sup> Estimates suggested that developing independent Russian capabilities would take until 2030.<sup>96</sup> Analysis by the U.S. Defense Intelligence Agency also suggested that Russia has not been able to achieve its import substitution program goals, resulting in challenges for its space system production effort.<sup>97</sup>

Challenges posed by sanctions that limit imports exacerbate many of the other challenges addressed in this article. For example, experts have suggested that sanctions have hindered Russia's development of hardware for its national space station, which had to be redesigned to avoid Western electronics designers originally expected to be available.<sup>98</sup> While Russia has reportedly turned to China in the past, China has not indicated

a willingness to help Russia circumvent sanctions put in place in 2022.<sup>99</sup>

#### *Implications for Russia's Space Program*

As Dmitry Rogozin acknowledged, the imposition of sanctions that affect the Russian space program is not new – Russia has been dealing with similar sanctions since 2014. These sanctions have forced Russia to attempt to develop domestic production capabilities, but its efforts have been slow and not fully successful. The new sanctions will continue to push Russia in this direction, slowing development, and potentially resulting in greater domestic Russian capability and/or greater ties to China.



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# COUNTERSPACE CAPABILITIES AND DIPLOMATIC ENGAGEMENT

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## Counterspace Capabilities

The NATO Strategic Concept report acknowledges that strategic competitors and potential adversaries have invested in technologies that can “degrade our space capabilities, target our civilian and military infrastructure, impair our defense and harm our security.” Even as Russia’s civil space program has faced severe cuts, investments in military and counterspace technologies have been a priority.<sup>100</sup> Russia has been increasing its development of such counterspace capabilities in recent years, with the provocative rendezvous and proximity operations of the Luch inspector satellite, testing of its “nesting doll” anti-satellite weapon technology, and culminating in the destructive anti-satellite test carried out in November 2021, which generated more than 1,500 pieces of debris.<sup>101</sup>

Analysis of Russian military doctrine suggests that Russia sees counterspace technologies as a tool to provide asymmetric capabilities to offset allied military advantages from space.<sup>102</sup>

This approach has been on display in the war in Ukraine. While Russia has not attacked objects in space, it has conducted numerous non-kinetic attacks on space systems, including the jamming of GPS and communications systems, as well as cyberattacks on satellite networks.<sup>103</sup> However, some have suggested that these attacks have been less widespread or advanced than expected.<sup>104</sup>

Because Ukraine’s national space resources are limited, a significant portion of its space capability has come from commercial entities in the United States and European nations. Russia demonstrated a willingness to attack commercial

infrastructure with its February attack on the Viasat network, which impacted not only Ukrainian military communications, but also damaged terminals for thousands of civilian customers in Europe and affected thousands of wind turbines in Germany.<sup>105</sup> Likewise, cyberattacks on the Starlink system have reportedly ramped up as that system has become increasingly crucial to the Ukrainian military.<sup>106</sup> In a statement to the United Nations in October 2022, Russia suggested that such “quasi-civilian infrastructure may be a legitimate target for military attack.”<sup>107</sup>

### *Implications for Russia’s Space Program*

Russia has made significant investments in its counterspace capabilities and has increased development and testing in recent years. Given the important role space assets are playing in the war in Ukraine, Russia is likely to continue to invest in this area. Jamming of GPS and communications satellites, including commercial satellites, is likely to continue, and additional cyberattacks can also be expected. It is not clear under what conditions Russia would escalate these attacks by, for example, carrying out a physical attack on a space asset, although some have suggested that Russia’s 2021 destructive anti-satellite (ASAT) test was meant to signal that Russia is willing to carry out such an attack. In the case of commercial assets, the fact that these systems are numerous – with many constellations, each made up of multiple satellites – suggests that a physical attack would not be effective. This may lead Russia to continue focusing its efforts on more effective, if less dramatic, jamming, spoofing, and cyberattacks.

With its civil and military space sectors in decline, Russia may also choose to further increase its focus on military and counterspace capabilities, if it sees this arena as the one in which it can best demonstrate its enduring space power. This could pose risks to stability and space security if Russia engages in additional destructing, high-profile demonstrations of its capabilities, such as with the 2021 ASAT test.

## Diplomatic Engagement

While Russia has been developing counterspace capabilities, it has also remained active in international diplomatic forums relevant to the space domain. Russia has a long history of pushing for the negotiation of a binding treaty to prevent an arms race in outer space or the placement of weapons in outer space. While these efforts have not been successful due to U.S. and European skepticism of their effectiveness and verifiability, Russia had also been engaged in broader international efforts to develop norms of behavior in space.

In 2021, the UN General Assembly approved a United Kingdom resolution that called for the creation of a working group of all nations to identify norms, rules, and principles of responsible

behavior in space to help reduce space threats.<sup>108</sup> The resulting U.N. Open-Ended Working Group on Reducing Space Threats was broadly seen as one of the most promising ways forward in international diplomacy on space security. Concerns were raised when Russia derailed a planning meeting held in early February 2022, raising numerous procedural issues that resulted in the first meeting of the group being pushed from mid-February to May.<sup>109</sup> However, many officials were pleasantly surprised when the week-long May meeting resulted in largely constructive dialogue, including from Russian representatives.<sup>110</sup>

### *Implications for Russia's Space Program*

Russia's leadership in international diplomatic forums provides an important opportunity for Russia to reinforce its role as a key player in global affairs and a great power in space.<sup>111</sup> While Russia faces significant challenges to maintaining its status and capabilities in other aspects of space, its ability to engage in diplomatic forums has not been reduced. This suggests that despite high tensions resulting from the ongoing war, Russia may be willing to continue meaningful engagement in efforts such as the U.N. Open-Ended Working Group on Reducing Space Threats or other international space diplomacy efforts.



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# CONCLUSION AND CONSIDERATIONS FOR NATO

While the power and reach of digital technologies Russia's space program plays an important role in the Russian identity and acts as a source of national pride and international prestige. However, the program has been in decline for almost a decade, following the annexation of Crimea. In many cases, the shifts in the Russian space program caused by the war in Ukraine were a continuation of trends already in place. Russian threats to pull out of the International Space Station and focus on a Russian-built station caused significant concern from global media, but similar intentions had already been announced prior to the war. Russia suspended Soyuz flights from French Guiana in response to sanctions, but Arianespace had already announced earlier that year that Soyuz flights from the launch complex were likely to be phased out after 2023. Russia halted sales of engines to the United States, but the final delivery of one of the two engine types had already occurred a year earlier.

Still, these changes do have an impact. Almost every decision – ending international partnerships, halting commercial launches, ending engine sales – will result in lower revenues and fewer capabilities for the Russian space program. These same decisions decrease the ability of Russia to engage in high-profile space projects that generate international prestige, increasing the speed of decline and the likelihood that Russia will lose its great power status in space. Given its financial challenges, Russia will likely see further reduction in the size and capabilities of its civil space program, particularly decreased capabilities to engage in human spaceflight and space science projects. The dramatic reduction in the Russian

share of the global commercial launch market, as well as the end of sales of rocket engines to U.S. customers, are unlikely to ever be reversed.

NATO allies will need to determine how best to respond to these changes in the Russian space program. While space can offer a unique domain for cooperation that builds mutual understanding and reduces tensions on Earth, it is also important to recognize that space is also a geopolitical tool in which interdependencies can be used to exert pressure and advance strategic interests.<sup>112</sup>

In the civil domain, NATO allies must determine how to respond to Russia's recent conciliatory approach to ISS engagement. Given the technically interdependent nature of the ISS, maintaining professional coordination in this area is necessary for the safe operation of the station, which benefits all ISS partners and is required to ensure astronaut safety. Continued engagement also ensures that some Russian resources are invested in civil space endeavors, rather than just military and counterspace capabilities. Russia's participation in the ISS also reduces the risk that the Russia's space program will collapse altogether, potentially resulting in missile technology proliferation and greater instability. However, allies should remain aware that if tensions continue to rise, continued joint operation of the ISS may once again be in question, and the development of contingency plans should be considered.

NATO allies should also consider how to respond to Russia's ongoing efforts to engage emerging space nations. A number of these countries,



such as the United Arab Emirates, Saudi Arabia, Egypt, Thailand, and India have also been actively exploring potential partnerships with the United States and other NATO countries. Emphasis on strengthening these partnerships and building new space-focused connections could help to increase the influence of NATO allies relative to Russia in these regions.

With respect to commercial activity, Russia's space program was, and is, structurally misaligned to compete in the modern global space market.<sup>113</sup> While some NATO nations will lose revenue from decreased exports to Russia or the need to find alternatives to Russian goods and services, many NATO allies will benefit from their accelerated growth in market share as they seek to assist customers left stranded by Russia's withdrawal from the market. The western advantage in commercial space capabilities, which has proven critical in Ukraine, will likely continue, and nations should remain aware that Russia may seek ways to thwart this advantage.

NATO had already recognized the importance of space as a warfighting domain and had

acknowledged the development of counterspace capabilities by Russia and other potential adversaries. Russia's use of jamming, spoofing, and cyberattacks has only reinforced this understanding and served to place greater emphasis on the need to deter and defeat such attacks. Russia's continued engagement in international diplomatic efforts provides an opportunity to improve the stability of the space environment. Working through these venues, possible misunderstandings or miscalculations relating to space assets in the ongoing war could potentially be identified and avoided.

However, progress will not be easy. An analysis of Russian perceptions of U.S. military activities in the space domain notes that actions tend to be interpreted through the lens of the state relationship at the time. Thus, when the political relationship between Washington and Moscow is more confrontational, the same actions are perceived to be more threatening.<sup>114</sup> Building common understandings and gaining agreement during a war will pose significant challenges.

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