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Research Article

Russia in Outer Space: A Shrinking Space Power in the Era of Global Change

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ABSTRACT

Since 2014, the Russian space sector has handled institutional rearrangement and external economic pressure. On the one hand, the establishment of the State Space Corporation Roscosmos intended to renovate a critical segment and save an industry that is one of the jewels of the Soviet legacy. On the other hand, the Russian annexation of Crimea triggered waves of financial and economic sanctions that crippled the country's access to space technologies and broader international cooperation in outer space. As a result of the dynamic, the Russian space program has been in a grey zone in recent years. On the eve of the war in Ukraine, the Russian government made a strategic choice for total decoupling from Western countries. The Russian decision stresses a trajectory already taken where space activities are increasingly becoming an instrument of deterrence. The military dimension increasingly defines the Russian space program, while LEO becomes an area for confrontation. To circumvent complete isolation in the international arena, Russia will attempt to maintain vigorous diplomatic actions to curb the technology desert and maintain vital space activities in the foreseeable future. Hence, this article aims to identify available tools that Russia may use to envision a new strategy in outer space. Considering the rupture between the West and Russia, we describe the long-term effects on the space industry. We finally highlight potential alternative cooperations that may allow Russia to build its space diplomacy around a network of peripheral states while the partnership with China remains restricted.

1. Introduction: the end of the post-Cold War era

Russia's invasion of Ukraine has, and is likely to bear, a critical impact on Moscow's outer space policy ambitions. The cascading effects of the war on Russia's space strategy can be observed domestically in the space industry and capabilities as well as internationally regarding cooperation with other space-faring nations and principles of responsible state behaviors in outer space.

For decades the Russian space sector was in trouble due to limited funding, obsolete infrastructure, low productivity, and endemic corruption. The current conflict only accelerates the brewing systemic crisis that began in the post-Cold War period. In a nutshell, Russia's space program has a shortage of competent and highly qualified staff, obsolete facilities and technology, and weak leadership [1]. The foundation of Roscosmos in 2015 did not resolve shortcomings that the industry faced, while the leadership has resulted in numerous criticisms within the country's space community [2,3]. Russia is bound to reconsider its role in outer space as it enters into decline. While the space program takes on an increasingly military dimension, what is the hold of the Russian Ministry of Defense? In this moment of decoupling from the West, how does Russia see its posture in space? What assets may the country put forward to its partners?

Taking into consideration the shifting paradigm in the Russian space field, the country's trajectory is unsettled but has a lasting weakening effect. For the Western research community, the research topic related to the Russian space program is getting opaquer as relations between Russia and the West are hardening. As indicative of this dark path, the Russian state significantly restricted access to information in the field [4,5]. Overall, this new condition will impact the work of researchers for years to come. This paper is structured as follows. First, an assessment of the Russian space sector and the increasing role of the Ministry of Defense is provided; subsequently, an examination of the development of the space program in a background of escalating

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tensions with the West is presented; then, an analysis of the Russian diplomacy and international strategy in outer space is performed; and finally, some conclusions and perspectives are highlighted.

2. Russia lost in space: the relentless downturn of a cutting-edge industry

2.1. The Soviet legacy: deadlock and illusion of the Russian space policy

Russian post-Soviet space policy relies heavily on the legacy of the Soviet space program. Generally, observers agree that Russia's key success in space activities through the post-Soviet period is limited to the maintenance of Soviet space technology and Soviet space infrastructure, with new projects, often ambitiously announced, bearing little fruit due to their abandonments, obsolescence, and chronic underfunding [6,7]. Early on, the Russian space program was characterized in terms of "turmoil" related to the economic instability of the 1990s, corruption, bureaucratic inertia, and institutional leapfrog [8–11]. The executive authority in the space sector, now state corporation Roscosmos, has gone through major structural reforms four times through the post-Soviet years, with at least eight turns of replacing its leadership [12].

Furthermore, developed under the strong influence of military interests in the conditions of high secrecy that was possible to maintain through centralized and official censorship [13,14], the Soviet space program turned space exploration into one of the central elements of national identity. Following the abolition of censorship and a growing public debate on Russia's future in space, an attempt was made to reform the Soviet-Russian space sector by models of the U.S. and European space institutions, particularly with independent expertise that was not institutionalized. The first post-Soviet Federal Space Program until the year 2000 did not address national identity explicitly [15], focusing instead on the economic survival of space industries and new possibilities for international cooperation on market terms.

However, the reformist wave of the early 1990s faded shortly, and its results failed to materialize [16]. The consequent consolidation of political power through the 2000s–2010s was marked by a gradual refurbishment of Soviet-era rhetoric of ambiguous competition and cooperation with the United States, majorly focused on national identity and Russia's position internationally. The five key themes of official space discourse—historical legacy as a great space power, international cooperation, modernization, militarization of space, and independent space capacity—have largely appropriated and recycled the Soviet space rhetoric for the sake of legitimizing Russia's superpower position. Nevertheless, while the Soviet legacy is constantly showcased, no explanations comparable to the master narrative of Soviet space [17] or the contemporary American ambitions [18] are offered as to why Russia joined the new Space Race more generally [19]. In this light, Russian post-Soviet space policy is best understood as reactionary towards the United States, pragmatic and instrumental to Russia's overall international policy. Importantly, Russia has also tried cooperation beyond its key Western partners and counterparts, such as with BRICS members through Medvedev's presidency. At least until 2012, Putin's return to office and the consequent annexation of Crimea in 2014, that cooperation appeared rather shorthanded and was referred to in the official documents as "international obligations" in contrast to "international cooperation" aimed majorly at the United States and Europe [19]. These divisions may equally be seen as adaptions of Soviet space policy to new contexts: the Soviet *Intercosmos* program, through which the cosmonauts of Warsaw Pact countries flew on Soviet spacecraft, was also a tool of political discipline and loyalty while stimulating the interest of the American-led block [20]. At the same time, the themes of independent space capacity and militarization of space activities have been growing in the official discourse since 2012, becoming the cornerstones of the official rhetoric. The new domestic spaceport Vostochny Cosmodrome, located in proximity to China and promoted politically as a guarantee of independence and a turn to the East, was founded in 2012, partially operational today. Addressing space professionals on the Cosmonautics Day on April 12, 2022, after the full-scale invasion of Ukraine had begun, Putin described the Soviet space program in terms of "fighting for the Motherland", using a rhetoric common to the official commemorations of WWII that are now employed to justify the invasion [21]. In his latest space-related speech on April 12, 2023, Russia's President framed activities in space in terms of "technological sovereignty", explicitly stressed in terms of military applications, and specifically pointed out the strategically contested Arctic region as an area of application of Russian space activities [22,23].

2.2. The inability to achieve a coherent and independent civilian space sector

When the Russian Federal Space Agency, Roscosmos, was established in 2015, the public corporation was designed to shape a global vision while controlling the whole industrial value chain. The new federal agency combined the functions of ordering party, contractor, and regulator of space activities. It comprises 75 manufacturing and auxiliary enterprises that employ fewer than 180,000 people. The Russian government now intends to restore an industry that has been in disarray since the end of the Cold War and reinstate complete control of the national space sector. For this purpose, the government has supported the state corporation in managing the sector's most acute problems, such as the indebtedness of its companies.

Roscosmos' governance architecture is planned to fulfill three core missions: regulation of the industry (both legally and technically); distribution of orders and resources of the industry; and an authorized representative of the owner (the Russian state) in most enterprises of the space industry—this includes mainly federal enterprises, institutions, and joint-stock companies with a predominant state share. As Skvortsov once noted, "these functions are almost constantly in conflict with each other" [24]. Being both owner's representative and customer, Roscosmos has to think about profitability and business value on the one hand and cost minimization and performance maximization on the other. This schizophrenic position makes the effectiveness of the space industry's management model unsustainable in the long term [25]. In other words, this ecosystem is at risk to collapse while the Russian space governance is not able to handle properly the implementation of its programs [26].

This imbalance is due to the character of the Russian model for space development which posits a dominant role for the government [27]. Thanks in part to Putin's rule to retain absolute political control over the process, space commercialization and innovation wholly remain within a state-centric pattern. Since 2000, this trend confers most commercial space flights to the Russian federal agency. Nonetheless, Roscosmos has been unable to suppress hurdles that cripple the space sector and properly modernize its space sector and build an effective state-centered segment under the complete control of the government. In the era of "New Space", Russia failed to transform the national civil space industry into a competitive one. For years, the Russian government and President Putin expressed discontent with the repetitive failures to fulfill directives on long-standing achievements in outer space [28]. As a result of this crippling situation and lack of governance efficiency,

the Russian government has undertaken severe budget cuts while the country endures deep economic stagnation [29].

2.3. The incremental takeover of the Ministry of Defense

Alongside the federal agency, the Ministry of Defense has played a progressively more critical role in recent years as relations between Western countries and Russia have deteriorated. While the division of tasks between Roscosmos and the Ministry of Defense is well defined, both compete to control strategic space infrastructure assets, which indicates the latter is increasing its influence in the space program [30]. Nevertheless, the two public institutions jointly define the country's space strategy.

Regarding space infrastructure, Roscosmos oversees the state enterprises that manufacture ballistic and cruise missiles, and the new Vostochny Cosmodrome, which was planned mainly for commercial flights and is not yet ready to host the long-awaited new generation of Russian rockets. The Plesetsk Cosmodrome—until 2016, Russia's only operated domestic spaceport based in Mirny, Arkhangelsk Oblast—is under the supervision of the Russian Space Forces (*Kosmicheskie voyska Rossii*), a branch of the Russian Aerospace Forces (VKS) [31]. Based in the Arctic region, it is devoted to launching military satellites. In recent years, these activities have increased, becoming an indispensable pillar in Russia's geopolitical ambitions and boosting its military capabilities.

In the meantime, military spending keeps the industry afloat with pending investments, such as testing new launch vehicles (e.g., the Angara rocket family) [32]. According to Luzin's estimates, the military budget for space activities is no less than 110–120 billion rubles ($1.6-$1.8 billion) for 2023, while the assessment does not take into consideration operational spending on military units and personnel involved in the space program as well as dual-use programs and projects in development [33]. In a budget decline context of the civilian space program, the Ministry of Defense takes the lead in Russian space activities. For the above reasons, the balance of power is decisively shifting in favor of the Ministry of Defense as the main driving force. On top of that, the open confrontation with Western countries reinforces this long-term trend. This restructuring brings the space industry back to its original format in the Soviet period: a sector under the supervision of military institutions [34].

3. Techno-nationalism and military doctrine: space as an instrument for geopolitical deterrence

In the war context, the course of Russian space policy was at a critical juncture since the end of the Cold War. The failure to transform the Federal Space Agency into a modern and innovative institution has been highlighted during the Rogozin tenure. In addition to the institutional shortcomings, the international situation has a lasting effect on the Russian space sector. Thus, Russian economic and financial isolation after the Crimea annexation in 2014, and its intensification following the full-scale war launched on the Ukrainian territory, heightened the military component of the space program.

3.1. The turning point of the Rogozin era (2018–2022)

Whilst the establishment of Roscosmos intended to improve the performance of the Russian space sector, the appointment of Dmitry Rogozin [35] has reversed the essence of the institution and moved it towards an accentuated politicization of its activities. Rogozin's personality and background have complicated the task of overhauling a sector still in crisis. His term of office between 2018 and 2022 acknowledged the transition from a crisis mode to a survival mode of the Russian space industry. During those years, Roscosmos' governance was taken in the grip of unfamiliar rhetoric and escalating tensions with Western countries that precipitated the structural shortcomings of the Russian space industry [36]. Since Crimea's annexation in 2014, Rogozin remained under Western sanctions [37]. The nationalistic tone that the leadership of the federal body has been taking since 2018 comes against the background of continuing tensions between Russia and the West. His constant media bluster to compete with American contenders, such as Elon Musk, did not hide financial scandal and loss of confidence due to repeated failures [38]. Since the appointment of Dmitry Rogozin as head of the federal agency, the latter continually made inflammatory and provocative statements that have damaged the credibility and reputation of the state corporation in a sector not used to such bravado [39]. Although the Russian space community remained skeptical that a non-expert could run the federal agency, Rogozin is subject to significant criticism. In the inner circles of the Russian space community, there is some disapproval of the way Roscosmos is managed [40]. Russian scientists even express their opposition to proposals suggested by Rogozin, such as the unauthorized activation of the German eROSITA telescope aboard the Russian Spektr-RG space observatory [41,42]. Beyond Rogozin's personality, Roscosmos' short-term vision, heavily criticized, does not include structural and sustainable solutions for the Russian scientific community. Nevertheless, Rogozin's track record is not entirely negative, as the Russian space community praised some achievements, such as the low accident rate of the rockets produced and launched [43].

This phase also occurs during a sharp deterioration in the relationships between Russia and the West that weaken the national space industry. In the war context, Rogozin has been particularly vocal in his support of the Russian military intervention in Ukraine [44]. This warmongering posture directly impacted the Russian space sector, which trapped it in this confrontational dynamic with the West. In July 2022, President Putin replaced D. Rogozin with Yuri Borisov, a former deputy at the Ministry of Defense [45]. This nomination has two purposes: first, a return to formal neutrality of Roscosmos in these activities; second, a further confirmation of the convergence between the Ministry of Defense and the federal agency. Aside from these short-term considerations in the leadership, Roscosmos' attempts to rectify the situation are essentially targeting the effects of the current industry crisis, including poor work performance, poor reliability of manufactured goods, and low levels of technology development. Following the meeting with Borisov on April 12, 2023, Putin specifically marked the first in the post-Soviet period series of 100 launches without emergencies as a sign of reinvigoration of the Russian space industry [46]. In the line of "technological sovereignty", the meeting was focused on the construction of the new Russian national orbital station (ROSS) that should replace the Russian part of the ISS, allegedly operative until 2028, and that was connected to the realization of the Russian Moon program, another area of promoted international contestation [47].

3.2. Life of the Russian space industry under international sanctions

The deterioration with the West started as early as 2014 when Russia annexed Crimea and instigated a conflict in Donbas. The economic and financial sanctions that were introduced against Russia increased the speed of decline of the space industry. With subsequent sanctions and the launch of an import substitution policy, the main task became to ensure the independence of the Russian space industry in basic space technology, which meant a decoupling from the international division of labor (industrial cooperation) [48].

However, Russia faces technological and financial blocks as part of the severe effects of Western sanctions. While Russia is less economically dependent on its space infrastructure than the United States and China, the country is trying to renew its satellite constellation. As the space industry relies on Western components, the satellite program has slowed down severely, while microchips are on a list of restricted imports. This means Roscosmos is no longer able to launch some satellites as planned, while over 30 satellites for military use have surpassed their warranted lifetime [49]. This is increasing the already significant critical gaps in technology standards compared to other space powers. Against the backdrop of crippling economic sanctions, President Putin called for work on R&D projects to continue, including creating next-generation transport rockets and nuclear space technologies. In addition, he specifically underlined the quantitative and qualitative potential of the country's satellite cluster under the Sfera program [50]. It envisages the deployment of a system of over 600 communications and remote earth sensor satellites. However, the schedule and federal funding have remained uncertain.

These cumulative delays, as well as the financial difficulties, highlight the weak state of the civil space sector. This situation could affect the pace and the scope of Russia's space infrastructure modernization, driving Moscow to rely on third-party providers, primarily China. In addition, the Russian government may hunt alternative sources of high-tech, aerospace, and military technology while compelling non-Western countries to evade the sanctions regime [51]. Systemic shortcomings lead emblematic space missions such as the Luna program to be further delayed in time [52]. Nonetheless, Russian troubles in deep space exploration extend beyond the technical, industrial, and financial aspects. The war context has further unfathomable ramifications for the Russian space community: as Luzin argues, it is unbearable to grasp a sustainable and effective scientific space program if “universities, research institutions, and the whole educational system tend to be isolated from cooperative ties with peers around the world, or if this knowledge sector is subordinated to state political ideology and fully controlled by the security services, like it is in Russia” [53].

At the industrial level, however, Russia seems to be turning to a model of autarky, where the political choice to develop domestic technology is a priority, implying a quicker shift towards self-isolation. The purpose is, put differently, to overcome the technology desert that Western sanctions mean to make. Finally, this will, in turn, increase even further the military's influence and cause a greater dependence by state enterprises on the dual character of the space industry.

3.3. Militarization of Russian space activities

The character of the Russian space ecosystem is quickly shifting to deeper and more integrated incorporation into the military program. In that respect, the Russian doctrine appears to be intertwined to answer the multifactorial challenges introduced by modern warfare. The concept is to design an integrated defense, particularly the aerospace defense forces. The integration of the Russian military infrastructure allows for dealing with the threat of an enemy as a system [54]. To implement the military doctrine into space, Russia has advanced a variety of counter-technologies enabling it to hold a strategic position. The goal is to preserve the power balance in that field. The Ministry of Defense works on three critical stretches: Direct Ascent Anti-Satellite (ASAT) weapons; disruptive systems against space and ground infrastructures; electronic and cyber counter-space technologies [55].

In light of renewing the military doctrine, the Russian army defined a critical approach to space: the art of the grey zone. In other words, the grey zone activities are the ultimate boundary before reaching outright aggression. In this respect, Russia intends to improve its military space capabilities in the following segments: jamming and radio intelligence; and capabilities against ground-based space infrastructure. Overall, the objective is to avert its adversaries from using their space-related infrastructure [56]. Russia may plan to employ soft-kill capabilities that disable, deny, or damage—3D concept—a satellite, rather than physically destroy it, which could imply further political and security consequences [57]. Consequently, the practice of grey zone activities involves staying away from confrontation with its adversaries. In the future, the expansion of satellite mega-constellations will widen opportunities for grey zone situations that Russia may exploit, and strategic plans for developing such constellations are currently being discussed by the Russian leadership [58].

Indeed, this infrastructure transformation responds to the need to improve its intelligence, surveillance, and reconnaissance (ISR) capabilities. These capabilities are critical in the defense space program, which capitalize on the Soviet legacy. Russian authorities are mostly building on old programs from the Soviet Union, including a positioning, navigation, and timing (PNT) system, robust communications, and ISR satellites.

From that perspective, the Plesetsk Cosmodrome remains a vital infrastructure mainly dedicated to launching military satellites. From the Arctic region, this spaceport provides a strategic pillar to apply Russia's geopolitical ambition allowing its armed forces to pursue the completion of the military satellite constellation. Among the diverse satellite programs, GLONASS remains a priority. Russian armed forces are proceeding to the replacement of older generation GLONASS-M with new navigation satellites GLONASS-K [59]. Also, other satellites are tested, often for military purposes. In September 2021, the Soyuz rocket sent a classified payload into orbit—the first Razbeg imaging satellite, also known as Kosmos-2551 [60]. In addition, the ground structure is used as a launch pad for counter-weapons testing. In November 2021, the Russian ASAT system proved its capacity to destroy a live satellite target (the Soviet-era satellite Kosmos-1408—launched in 1982) for the first time although the identified 1500 pieces of debris cloud (10 cm or larger) sharply contribute to a degraded environment for operating in low Earth orbit (LEO) [61,62]. Finally, the intensification of Russian defense space activities in LEO reflects a geopolitical pattern: a mounting military strain with the West.

4. Structural shift in Russian diplomacy in the outer space

Russian space activities took a new turn throughout the last decade, leaving its conditions from the post-Cold War era to envision a new geopolitical status and design a new diplomatic architecture. While the war launched on Ukraine ends a unique cooperation era with the West, it also redraws geopolitics in space [63]. If China could appear as the first beneficiary of this geopolitical shift, Russia may attempt to broaden its cooperation with non-Western partners in the space field.

4.1. The breakdown of the cooperation with the West

The Russian military offensive on the Ukrainian territory jeopardized three long decades of space cooperation between Russia and the West. During this period, Russia had earned a reputation as a reliable partner in space for scientific missions, making outer space a few areas of close and confident relations enabling it to surmount the existing geostrategic tensions [64]. In the post-Cold War context, Russia became a trustworthy and indispensable partner for the International Space Station (ISS) [65]. In 2013, the European Space Agency (ESA) and Roscosmos signed an agreement to work in partnership on the ExoMars program aiming to establish

whether life ever existed on Mars [66]. Despite the Russian annexation of Crimea, ESA and Roscosmos maintained their cooperation on this breakthrough scientific mission.

The long-standing space cooperation between Russia and the United States is suffering from critical setbacks while their bilateral relations incrementally deteriorate. In the last decades, the Russian space program was mainly active in the U.S. market by leasing its transportation services to NASA. That is to say, sales of commercial launches served as a pivotal connection between Russia and the United States. But this close cooperation terminated in 2020 with the rise of the private space company SpaceX providing the launchers that NASA needed to fulfill its missions for the ISS. Cooperation with the United States was a critical source of revenue for the Russian space industry. Since 2006, NASA has been purchasing seats for manned flights on Soyuz rockets: in the period between 2006 and 2020, total revenues amounted to $3.9 billion (for 71 seats) [67]. In the same vein, the Roscosmos subsidiary Energomash has been supplying the RD-180 engine to ULA (United Launch Alliance) for its Atlas V rockets since the 1990s [68]. The final sales of RD-180 were completed in 2021, ending three decades of close collaboration. Since 2014, the implementation of international sanctions against Russia has weakened its position in the commercial flight ecosystem, while U.S. federal authorities have stimulated the onset of a sizeable private sector to meet NASA's needs. Even though NASA and Roscosmos sustain their practical cooperation in orbit [69], Russia's journey in the international arena has resulted in a continual break with the West in the space sector.

Considering this new international condition, that reputation has been shattered, and few doors to cooperation remain open. For instance, the fate of the ISS is being hotly debated, as Roscosmos has regularly threatened to end Russia's participation [70]. This international consortium, started in 2000, acts as the last legacy of the post-Cold War era. Initially, the driver of this project was to bring together Russia and fourteen other countries, including France, Japan, and the United States. Since 2014, Russian space officials have also been proposing a national orbital station (ROSS) to replace the Russian part of the ISS; these proposals have intensified after the invasion of Ukraine, with the first designs released and matters of national security emphasized [71]. If operations in the ISS continue, other collaborative projects between Western countries and Russia have collapsed.

In the early stage of the war, Roscosmos signaled the end of Russian launches from Europe's spaceport (Guiana Space Centre) based in Kourou, French Guiana [72]. In response, Arianespace suspended all Soyuz launches and announced support for long-term and alternative solutions [73]. The tit-for-tat process of degradation of relations leads to a deadlock. Overall, the cooperation between the Russian federal agency and ESA has been stopped, which involves a significant shift in the modern space cooperation sphere. Emblematically, Russia has been excluded from the ExoMars program—the European life-hunting Mars rover mission [74]. Initially, ESA suspended Russian participation in the rover mission due to the conflict and the ensuing economic and financial sanctions. The breakdown extent between ESA and Roscosmos appears to be unparalleled, while cooperation with Europe has proven to be quite robust between 2014 and 2021 [75]. In the meantime, NASA upholds practical cooperation with Roscosmos in the ISS framework, despite the downsizing of its relationship.

Since Russia's invasion of Ukraine started in February 2022, Roscosmos' conduct has damaged long-standing international partnerships in space exploration. From a general perspective, the relations between the West and Russia are lastingly damaged in which the breakdown of confidence hinders the continuation of cooperation programs in the space field. Retrospectively, the fracturing of this relationship built in 1991 would probably mark 2022 as the end of the cooperative era between the two blocs [76]. This geopolitical shift is leading Russia to move faster to reposition itself on the global scene and be an alternative space power.

4.2. The fragile thread of the Russia-China strategic alignment in the space field

To address its geopolitical agenda of setting up a multipolar world, Russia moves closer to China, which stands as a cornerstone of this strategic shift. The understanding between Russia and China in outer space covers multiple layers: diplomatic, scientific, industrial, and military. On the diplomatic side, they jointly coordinate their bilateral channel to work on a treaty on the “Prevention of an Arms Race in Outer Space” (PAROS). In 2014, Chinese and Russian delegations submitted a new draft, “Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects” (PPWT), which prompts “not to place any weapons in outer space” [77]. Both countries express a long-standing shared vision “to make all necessary efforts to prevent the weaponization of space and an arms race in outer space preventing an arms race in outer space” [78], at the same time, they remain opposed to the U.S. plans to develop global missile defense. While both countries advocate a similar view on the use of space, Russia and China voted against a British-introduced resolution in December 2020 that seeks to establish “norms, rules and principles of responsible behaviors” in outer space, which passed at the United Nations General Assembly with 164 countries in favor [79]. This stance recalls the conflictive context on the global stage and the fact that both countries are opposed to a one-sided definition of the normative rules of international relations.

On the military side, Russia is helping China's efforts to build an early-warning system, which is part of the ever-expanding “strategic partnership” [80]. The system includes a space-based echelon, which comprises satellites that can detect launches of ballistic missiles from the territory of any state in real time. In this respect, Russia-China space's policy shared vision, including further military integration, intend to challenge Western countries. In practical terms, Russian support in developing an early-warning system in China will cover a large territory from the Arctic to South-East Asia. This joint effort underlines a pragmatic approach by both sides to address the military challenge posed by the United States.

Regarding civil scientific and technical cooperation, China and Russia try to allow mutual benefits. Roscosmos and the China National Space Administration (CNSA) back a bilateral program that includes several sections with joint working subgroups. Among cooperation matters, they pledged to create a shared lunar station and deep-space data center. Even though it is limited to technical cooperation, the five-year agreement consists of special-materials development, collaboration in satellite systems, Earth remote sensing, and space-debris research [81]. One of the emblematic projects relates to the Moon: Russia and China are coordinating a series of lunar missions that ultimately aim to build a permanent research base on the south pole of the Moon by 2030 [82]. Although there is no clear schedule for implementing such a project, Russia's participation remains uncertain with dried-up funds, while the war context could hardly achieve this ambition. Firstly, China may pursue what kind of contributions Russia could valuably bring to the International Lunar Research Station (ILRS). In this regard, the programmed launch of the Luna-25 automatic lunar probe marks a turning point, while the last mission of this kind was in 1976 [83]. Then, China has the upper hand in the lunar program and seeks to entice other partners [84]. Given such a backdrop, Russia increasingly looks like a junior partner. Overall, this bilateral cooperation has given Russia the prospect of pursuing an ambitious scientific

voyage that the country can no longer afford [85]. Equally, China, which is rolling out a comprehensive program in the space sector, is making this space cooperation a cyclical rapprochement rather than a strategic one. In other words, the Chinese government favors limiting its space cooperation with Russia instead of being committed to long-term and costly joint projects [86].

Consequently, China and Russia can no longer hide their widening gap. While under economic sanctions and without legal access to European and U.S. space technologies, the Russian space sector may rely upon the microelectronics supply from China [87]. The emergence of technological dependence on the Chinese partner is a long-term threat to the self-reliance of Russian activities in outer space. Nonetheless, the country aims to minimize non-necessary purchases to avoid technological dependence. Thus, Russian–Chinese cooperation in outer space is unlikely to go beyond targeted and largely symbolic collaboration [88], and the assertive new foreign policy conducted by China may restrict to further deepening of this partnership [89]. As China intends to become a normative power, including in outer space, it should act as a more systemic and global space power. Meanwhile, the ramifications of Western sanctions for the Russian economic, financial, technological, and scientific ecosystem are so significant that the potential benefit of such a partnership for the Chinese side is no longer apparent. As a result, Russia remains compelled to broaden and redefine the scope of its partnerships in outer space.

4.3. Becoming the mentor of alternative and rogue powers in LEO

Based on the principles of science diplomacy, Russia uses space as an instrument for channeling international cooperation and thus places itself as a strategically important player. Nonetheless, a global strategy is lacking to offer any consistency for Russian space diplomacy with other major powers. While Roscosmos unveiled ambitious programs pointed at the Moon or other planets in the solar system [90], the systemic difficulties previously mentioned restrict such achievements. The loss of prestige and influence accelerates a declining path while the country's deep space programs are fading. Instead, Russia's future in outer space is increasingly restricted to LEO.

To diversify its space partnerships, Russia has sought to establish international space cooperation programs in Africa and Southeast Asia. However, this diversification policy, which aims to reduce the strategic dependence of Russian space activities on the Western powers, reveals to be challenging. For instance, space cooperation within the BRICS countries still exposes divergence of interests, priorities, and capabilities. Consequently, these partnerships are fragile networks that cannot compensate for Russia's technological and industrial decline [91]. Russia intends to extend its GLONASS network across the world by developing its ground infrastructures [92], such as in Brazil or Argentina. Russia expects to convert itself as an intermediary stakeholder for non-space powers. But, many countries are taking the initiative to support ambitious national space programs like Turkey [93] and the United Arab Emirates (UAE) [94]. The speed of the projects developed by these countries in outer space tends to be competitive with the Russian space exploration program [95]. These new space powers can sustain cooperation in specific areas, including training programs for future astronauts, as Turkey has done [96]. Similarly, Russia and the UAE share a common political vision and interests on the global stage [97]. Instead, to act as an initiator, Russia looks like a provider of expertise, thus converting into income.

The paradigm shift is driving Russia to reassess its priorities in space. The construction of a space station (ROSS) is critical to sustaining the capacity to fly cosmonauts into space [98]. Therefore, the legitimacy of Russia as an influential player is at stake with other countries: it is a matter of maintaining skills and a long track record that few countries in the world have. Thus, more than the ambition to carry out missions in deep space, the Russian space program, given its nature and evolution, is bound to consolidate its activities in LEO. As above mentioned, these activities are ever more marked by their military use.

In this respect, Russia can assist allied countries such as North Korea and Iran. This perspective fosters the pariah dimension this country has turned into with the Western countries. Consequently, Russian space activities are shifting increasingly towards states that also belong to this group. A group whose common point is to be subjected to international sanctions regime [99]. Since the beginning of the 21st century, Russia and North Korea have been working together to strengthen their economic cooperation [100]. In pursuing this path, the war context has promptly brought the two countries closer together, as North Korea voiced in favor of supporting the Russian military action in Ukraine [101]. For many years, North Korea has been trying to obtain Russian support in the development of its space program [102]. Although limited, Russia is now more inclined to back the North Korean aerospace program, which is military, as evidenced by the use of GLONASS for missile launches [103]. Similarly, the proximity between Iran and Russia in the space field is even more striking. For several decades, Moscow and Tehran have been working closely together [104], including on satellite and missile cooperation. This close cooperation is illustrated in particular by the presence in Iran of Russian specialists engaged “in the development of military and double-use technology” [105]. Since the end of the Cold War, the transfer of sensitive technologies has been one of the strategic pillars of the bilateral relationship [106]. In practical terms, Roscosmos is assisting the implementation of the Iranian satellite program, for instance, with the launch of the Earth-observation satellite “Khayyam”—a Russian-designed satellite [107]. This effort is an example of the country's readiness to mentor hostile powers to the West, also known as rogue states [108], including the risk of exporting this antagonism into outer space.

5. Conclusion

The 2022 war marks a decisive disruption for the Russian space sector. The inability of the national institutional authorities to modernize the civil space sector, resize its industry, and improve its commercial performance since the beginning of the 21st century has sidelined the space program on the international stage. Since that period, the transition of the Russian space sector into a viable economic model remains unachieved. The path of Russian space is now towards a shrinking ecosystem due to the demographic, economic, and technological evolution on the domestic level. Although Russia still benefits from a competitive advantage associated with its extended presence and experience in outer space, this advantage is waning due to fast-growing investments by state and private actors. The failure to mature a profitable commercial segment underlines the Russian space industry's institutional inability to compete with other space powers. Instead, the upper hand of the Ministry of Defense on space programs is further diverting their activities into a military objective. In other words, the further military use of outer space may lock Russia into an even more isolated space stakeholder.

The difficulties in reforming this sector for three decades are now reaching a critical threshold. Without a doubt, the war mobilization process within Russian society induces long-term destructive effects on the ecosystem of the space industry and the fulfillment of its programs [109]. As long as the war effort cripples the Russian socioeconomic organization, it may become a structural pattern. The space industry may define a new approach

with limited means, implying downsizing its ecosystem and closing some part of the inherited infrastructure in coping efficiently with this shift. The end of cooperation within the ISS by 2030 concludes the post-Cold War period that witnessed the flourishing partnership between Russia and Western countries [110]. The darkening dynamic opens new processes and may generate a newly comprehensive geopolitical arena in outer space that may undermine Russia's long-standing role. Against the backdrop of this collision course, Russia is gradually moving towards a form of autarky leading the country to maintain its independence but isolating itself from other major space powers. The preservation of its strategic autonomy in outer space will depend on the capacity to process domestic electronic components for the space industry or sustainably provide them from alternative suppliers. The strategic alignment with rogue actors leaves Russia in a precarious position. Thus, the international community is called upon to prevent the weaponization of outer space while securing access to Earth's orbit, and space infrastructure is critical for the functioning of our societies [111]. As Jackson stated, outer space has become a critical area through which to respond to or negate Western strategy and capabilities and influence global norms [112]. In general terms, Russia's posture as a leading space power is eroding to be marginalized and may turn into a disruptive factor.

Authorship contributions

Florian Vidal: Conceptualization, Formal analysis, Writing - Original Draft, Writing - Review & Editing.

Roman Privalov: Writing - Review & Editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

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