

Challenges of Space Law in The Grand Duchy of Luxembourg

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The article examines the innovative space legislation of the Grand Duchy of Luxembourg and its broader implications for the Western democratic community. The 2017 Law on the Exploration and Use of Space Resources established a pioneering legal framework that formally recognized property rights for private actors, setting a precedent within Europe. Luxembourg has positioned itself as an open jurisdiction that attracts international firms, including those with non-European affiliations. Particular attention is directed toward engagement with China under the 2018 Memorandum of Understanding, which opened channels for scientific and technological collaboration. At the same time, credible concerns have been raised regarding potential dual-use applications of emerging technologies and the enforcement gap in ensuring compliance with international sanctions, as highlighted by the Spacety episode. These developments underscore the policy challenge of balancing open investment environments with strategic safeguards. The study suggests that Luxembourg's model can generate benefits for the West, but only if reinforced by robust export-control regimes, transparent oversight mechanisms, and sustained multilateral coordination.

Keywords: democracy, dual-use technologies, international control, private actors of space activities, space law, space legislation, space technologies, strategic security, totalitarianism, peaceful use of outer space.

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Introduction

In the contemporary global context, outer space is increasingly viewed not only as a domain of strategic competition but also as a potential theater of military conflict between democratic states and authoritarian regimes. This reality necessitates a deeper legal analysis of emerging models of space governance. Luxembourg, though a small European state by territory, has established a unique regulatory framework for commercial space exploration, particularly through the adoption of the 2017 Law on the Exploration and Use of Space Resources (De Man, 2017). This law effectively recognized property rights of private actors to resources extracted in outer space. In conditions of such legal uncertainty, it is essential to conduct a doctrinal assessment of the conformity of this model with international law and the security challenges posed by totalitarian states. Moreover, the urgency of the issue is reinforced by the rapid commercialization of outer space, where innovative technologies are increasingly deployed for dual-use purposes.

The second set of challenges is related to Luxembourg's foreign policy posture, which simultaneously declares neutrality in space activities while maintaining membership in NATO and the EU. In this context, the country's space legislation creates potential legal conflicts between its obligations to allies and its commitment to open jurisdiction. This tension raises concerns about compliance with the fundamental values of the European Union, including respect for human dignity, freedom, democracy, equality, the rule of law, and human rights (The protection, 2024). Many of these values are systematically violated in the People's Republic of China (Mcque, 2025; China, 2025). The practical ability of foreign state-affiliated companies from authoritarian regimes to register subsidiaries in Luxembourg as "private" entities opens pathways for circumventing international sanctions. A particularly illustrative case is that of the

Chinese company Spacety (U.S., 2023), which, through its scientific presence in Luxembourg, gained access to European markets, even though its alleged transmission of data to Russian armed groups may contradict principles of the peaceful use of outer space.

The third dimension of relevance concerns the urgent need to establish an international mechanism to mitigate risks in space law. At present, the international legal system lacks sufficiently effective instruments for monitoring transnational actors in outer space. The only tangible deterrent remains the imposition of sanctions, which may result in criminal liability for culpable entities (Persad-Ford, 2022). However, for private participants operating through partnerships, even when these include entities effectively controlled by authoritarian governments, this is unlikely to serve as a meaningful barrier. Accordingly, Luxembourg's proposed combination of openness and recognition of commercial space activities requires additional justification in terms of strategic security. The presence of initiatives such as ESRIC and LuxIMPULSE reflects Luxembourg's aspiration for innovation but does not eliminate the risks that this legislation may be exploited by authoritarian regimes to undermine democratic states.

1. The Grand Duchy of Luxembourg as a Pioneer in the Formation of Commercial Space Law

In recent years, Luxembourg has consolidated its position as one of the leading centers of the space economy in Europe, beginning its engagement in this sector in 1985 with the establishment of SES (Space, 2025), now a global leader in satellite communications. A subsequent milestone was Luxembourg's accession to the European Space Agency in 2005 (Luxembourg, 2005), which enabled national companies to integrate into international projects. The current space strategy, updated by the Ministry of the Economy (2023–2027), combines economic growth with principles of sustainability and responsible space utilization. Its implementation is coordinated by the Luxembourg Space Agency, which promotes innovation, builds national competencies, and advances Luxembourg's space sector on a global scale (Ministry, 2025).

The true breakthrough, however, lies in Luxembourg's legislative achievements in the governance of outer space. In 2017, the country adopted the Law on the Exploration and Use of Space Resources, which recognized the right of private companies to own resources extracted from asteroids or other celestial bodies. According to space policy experts, a key feature of this high-level national legal act is its compliance with international space law, particularly the 1967 Outer Space Treaty. While it does not contradict the principle of non-appropriation of celestial bodies, it does acknowledge property rights over resources once they have been effectively extracted (About, 2025).

The specific innovations of Luxembourg's Law of 20 July 2017 on the Exploration and Use of Space Resources are manifested in its pioneering recognition of space resources as objects of private property rights. This approach demonstrates a pragmatic adaptation of international public law to the conditions of a market economy. By doing so, the country created a legislative basis for the commercial exploitation of asteroids, opening a legal framework for private investment in the space industry. Luxembourg even outpaced the United States, which adopted a similar law in 2015 but without providing such a clear legal status for property rights (Law, 2019).

A second important feature lies in the legal nexus requirement. Authorization may only be granted to companies incorporated under Luxembourg law that maintain their central

administration and office within the country. This effectively establishes a legal corridor for international corporations willing to relocate or register their activities in Luxembourg. It ensures not only fiscal benefits for the state but also administrative oversight of operators. The conditions for authorization include requirements for the professional reputation of management, as well as the existence of adequate financial, technical, and organizational guarantees.

The third innovation is a multi-layered licensing and mission assessment system. The law requires the submission of a detailed program plan, risk assessment, financial guarantees, and an independent audit. A key element is the requirement for financial security, either through the operator's own capital or via guarantees issued by independent banks or insurance companies not affiliated with the operator. Additionally, a tiered application fee ranging from €5,000 to €500,000 based on complexity acts as another barrier to unqualified applicants (Law, 2019).

The fourth institutional innovation concerns oversight and accountability of operators. The Minister of the Economy and Space Activities is authorized to exercise control not only at the stage of authorization but throughout the entire duration of a mission. Authorization may be revoked if activities cease or conditions are violated. Space companies also bear full liability for any damages caused, both during missions and during preparation. Such a system is rare in international space law, where liability is usually considered only in the intergovernmental dimension.

The fifth innovation establishes a mechanism of legal accountability. The law prescribes criminal sanctions for violations of the authorization process. Violations of Article 2 may result in imprisonment of up to five years or fines of up to €1.25 million. Other major violations are punishable by up to one year of imprisonment or fines of up to €500,000. Particularly noteworthy is the court's power to impose daily fines of up to €1 million for each day the violation persists (Law, 2019).

In his publication, Laurent Thailly summarized the conceptual foundations of Luxembourg's Law of 20 July 2017 on the Exploration and Use of Space Resources, the first legal act in Europe to regulate private property rights over resources extracted in outer space. Thailly emphasized that the law created a transparent system of licensing and oversight, enabling commercial operators to obtain rights to resources from celestial bodies, particularly asteroids. He outlined the necessity of mission risk assessments, proof of financial capacity, and mandatory external auditing. Importantly, this legal framework is not an isolated initiative but part of the national SpaceResources.lu program, designed to position Luxembourg as a European hub for space mining. Within the framework of this program, the government allocated €200 million to support companies registering under Luxembourg jurisdiction (Thailly, 2017).

In addition to the national dimension, Thailly highlighted Luxembourg's international perspective, especially its ambition to promote the creation of a global legal framework within the United Nations for the extraction of resources from near-Earth objects. Cooperation has already been established with the European Investment Bank, which provides advisory support to ensure access to financing for space projects. Thailly underlined that Luxembourg deliberately seeks to diversify its economy, historically dominated by the financial sector, through investments in space. Such a strategy allows the state to become not only a European but also a global hub for the space industry (Thailly, 2017).

In 2020, Luxembourg adopted the Law on Space Activities, which served as a logical continuation of the earlier legislation. This law regulates licensing procedures, mandatory insurance, technical audits, and oversight of all space-related activities. Its scope extends to activities carried out both from Luxembourg's territory and abroad, provided that the operator

is a Luxembourg citizen or a legal entity incorporated under Luxembourg law. The law does not govern the extraction of space resources, except for Articles 15 and 16 concerning the registration of objects. It sets forth detailed definitions of “operator,” “space activity,” “space object,” and “harmful consequences,” thereby creating a unified terminological basis for future regulations. The legal regime obligates operators to conduct activities exclusively in accordance with authorization requirements and Luxembourg’s international commitments. Operators bear full liability for damages caused during their activities, including the preparation stage. A distinctive feature of the law is the system of individualized licensing for space activities. It establishes requirements for the operator’s legal presence in Luxembourg, adequate financial, organizational, and technical resources, internal control mechanisms, and independent auditing. Company executives must have impeccable reputations and proven experience in the space sector. The law also provides for a public registry of space objects, into which every launch must be recorded. The Minister has authority to suspend shareholder voting rights or annul previous votes in case of violations (Law, 2020). Overall, Luxembourg’s space law rests on a dual structure: combining property rights over extracted resources with strict standards of safety, transparency, and accountability (European, 2025).

Thus, the Grand Duchy of Luxembourg became the second state in the world, after the United States, and the first in Europe to adopt comprehensive legislation governing the extraction of space resources and the regulation of space activities. Through the 2017 Law on Space Resources and the 2020 Law on Space Activities, Luxembourg established a dual legal framework that encompasses both property rights over extracted resources and high standards of licensing, oversight, and accountability. These laws are consistent with international space law while simultaneously creating favorable conditions for foreign investors and commercial operators. The state has combined legal innovation with institutional support, most notably through the SpaceResources.lu initiative. This approach has enabled Luxembourg to transform itself into a European and global hub of the space economy.

1.2. The Emergence of Luxembourg’s National Space Law

According to Luxembourg scholars and space law researchers Blazej Gladysz-Lehmann, Bob Calmes, and Laurent Schummer, the development of national space legislation is a key instrument for Luxembourg’s integration into the global space community (Gladysz-Lehmann et al., 2024). Following their approach, Luxembourg views outer space as a domain of entrepreneurship and strategic state development, which is clearly demonstrated by the establishment of the global satellite operator SES and the legal support of private companies interested in space exploration. Since 2016, the state has implemented the SpaceResources.lu initiative, aimed at creating a favorable environment for commercial activities beyond Earth (Spaceresources.lu, 2019). The adoption of the 2017 Law on Space Resources provided legal guarantees for the recognition of property rights over resources extracted from celestial bodies. This step positioned Luxembourg as a pioneer in the legal interpretation of the 1967 Outer Space Treaty under the conditions of the modern economy. According to the authors, the country’s legislation ensures a balance between compliance with international obligations and the promotion of investment attractiveness. Luxembourg’s National Space Agency, the institutional basis of space governance, was established in 2018 at the initiative of the Ministry of the Economy (Luxembourg, 2019).

Since July 8, 2021, the agency has operated as a state-established foundation with a degree of autonomy in decision-making. However, most members of its supervisory board are appointed by the government upon recommendation of the minister, which guarantees political accountability

and strategic governance. The agency coordinates national policy in the field of space research and technology implementation, processes mission applications, and supports the growth of the space sector. Its functions extend beyond regulation to fostering partnerships with the European Space Agency and private companies. In this way, the Luxembourg Space Agency (LSA) plays the role of a center of public administration in Luxembourg's space policy.

The key legislative acts forming the legal foundation of Luxembourg's space law include four core documents: the 1991 Electronic Media Act, the 2005 Frequency Management Act, the 2017 Law on Space Resources, and the 2020 General Law on Space Activities. A system of financial guarantees for missions has been introduced, based on either own funds or insurance mechanisms. Violations of the laws entail serious sanctions, including arrest, fines, or the revocation of licenses (Gładysz-Lehmann et al., 2024).

Thus, the development of Luxembourg's national space law lies in the state's deliberate combination of economic freedom and entrepreneurship with clear administrative-legal control mechanisms. The legislation promotes the legalization of private initiatives in space resource exploitation while creating a secure environment for investors and technical operators. At the same time, strict requirements for auditing, reputational verification, insurance, and compliance with licensing regimes ensure a balance between innovation and security. The Luxembourg model demonstrates how a small European public entity can establish an influential presence in global space policy. Nevertheless, it is important to recognize that Luxembourg's space law remains at an early stage of development. In many respects, it is still aligned with general international space law, requiring further institutionalization, practical application, and scholarly doctrinal analysis.

1.3. The Legal Status of the Luxembourg Space Agency

The official establishment of the Luxembourg Space Agency (LSA) took place on 12 September 2018, when the government of the Grand Duchy launched a new institution with the purpose of advancing the commercial space economy. The agency was created as a business-oriented body that does not directly engage in research or launches but instead coordinates and supports the growth of innovative entrepreneurship in the space sector. Subordinate to the Ministry of the Economy, LSA operates through an extensive network of national partners in science, education, finance, and technology. Its activities are aimed at attracting investment, developing human capital, and supporting infrastructure for space start-ups. The agency also manages the SpaceResources.lu initiative and shapes national policy in the field of international space relations (Luxembourg, 2018a).

LSA operates under the legal framework of the 2020 Law on Space Activities, which delegates licensing, oversight, and registry functions to the Ministry of the Economy and the agency. LSA administers the National Registry of Space Objects and implements the SpaceResources.lu program in cooperation with the Ministry, ESA, and other international organizations. Within its legal mandate, the agency acts as a co-executor of agreements with ESA, such as the establishment of ESRIC, demonstrating close interaction between national and supranational institutions. While the Ministry defines the strategy for space development, the agency is tasked with practical implementation under the 2023–2027 strategic plan. LSA thus functions as a focal point linking state institutions, private actors, and international organizations (ESA, UN, EIB). Its activities adhere to international space law (Treaties of 1967, 1972) and national legislation (2017, 2020).

LSA has a broad mission to stimulate the development of space technologies and business, including investment support, innovation, and R&D. It promotes competence-building in science and education, for instance through cooperation with the University of Luxembourg and the creation of ESRIC. LSA represents Luxembourg in the international space community – ESA, UN, and EU – ensuring the country’s participation in conferences and treaties. It coordinates financing programs such as LuxIMPULSE, Fit4Start, incubators, and grant allocations for space technology development. The agency is also responsible for satellite communications and spectrum regulation under the 1991 law and related legal acts. Another function includes monitoring space objects, maintaining registration, and managing risks for the state and investors through licensing. Among its key duties, LSA issues, renews, and revokes licenses on behalf of the state, supervising compliance with the 2020 Law on Space Activities. It maintains the National Registry of Space Objects and monitors the parameters of launched satellites, ensuring Luxembourg’s compliance with international obligations (Legal, 2025).

The agency is authorized to coordinate insurance and financial guarantees, including tax incentives (such as exemptions for insurance contracts). It may approve changes in operator ownership structures and assess the professionalism, integrity, and experience of management (Wellens & Heirbrant, 2020). LSA also has the power to transfer control of objects to third parties in cases where the initial operator ceases activity, thereby ensuring flight safety or deorbiting. Beyond national responsibilities, it engages in bilateral agreements – for example, ESRIC collaborations with LIST, ESA, and EIB. LSA is empowered to approve the legal status of mission participants, evaluate applications for compliance with Luxembourgish law and international obligations, and revoke or suspend licenses in cases of violations or risks to safety and the environment. It reviews the technical characteristics of satellites through registration documents, including orbit and signal data, and requires operators to provide financial guarantees or insurance through independent institutions, benefiting from associated tax incentives (Luxembourg, 2020).

Thus, the legal status of the Luxembourg Space Agency (LSA) is defined as that of a state institution, established on 12 September 2018 under government initiative and subordinate to the Ministry of the Economy. It functions as a public foundation with specialized powers in licensing, oversight, and coordination of space activities under the 2020 Law on Space Activities. LSA performs both administrative functions – such as issuing permits, maintaining the National Registry of Space Objects, and supervising compliance with international obligations – and policy functions, implementing the SpaceResources.lu strategy, cooperating with ESA, EIB, and other international organizations. The agency is further authorized to monitor technical and financial aspects of operators’ activities, provide incentives, and assume control of space objects when necessary to safeguard security.

1.4. Luxembourg’s Space Programs Related to the Exploration and Use of Outer Space

Luxembourg’s space policy provides for the strategic support of innovative projects through specialized financial programs aimed at advancing the commercial use of outer space. One of the leading initiatives is the national program LuxIMPULSE, implemented jointly with the European Space Agency. This program offers partial funding for start-ups, research institutes, and companies engaged in developing innovations in satellite technologies, navigation, Earth observation, and asteroid resource exploration. LuxIMPULSE promotes partnerships between scientific institutions and business, fostering synergies between research and technological

production. Priority is given to projects with strong commercialization potential in the global market. Importantly, financial support is combined with expert guidance and techno-economic assessments (LuxIMPULSE, 2023).

Beyond LuxIMPULSE, the government of the Grand Duchy provides additional forms of state aid under its Research, Development, and Innovation (RDI) policy. These programs enable companies to finance not only research phases but also market preparation, testing, certification, and the launch of space products. Integration with the academic sector plays a vital role, as universities and research centers develop new competencies in the space field. In parallel, Luxembourg is building a national infrastructure for satellite data processing and application. The programs include both grant-based and mixed funding mechanisms, such as loans, risk insurance, and equity investments (Communication, 2022).

A distinctive feature of Luxembourg's model is the active use of its financial potential to foster space entrepreneurship. As one of Europe's leading financial centers, Luxembourg has become a hub for venture capital, private equity funds, and business angels interested in space technology financing. In cooperation with private partners, the government is creating a National Space Investment Fund, designed as a dedicated financial instrument for direct investments in promising technology companies. The primary objective of this fund is to provide start-ups and small innovative enterprises with early-stage capital to implement NewSpace projects (Luxembourg, 2019).

Thus, Luxembourg implements its strategic space policy through the LuxIMPULSE program, which provides partial financing for innovative projects in the space sector. The program is designed to strengthen business-science partnerships and accelerate the commercialization of innovations on global markets. At the same time, the government supports research, development, and innovation (RDI) through a wide range of state aid mechanisms. A key feature is the combination of grants with financial instruments, including insurance, loans, and investment funds. By actively leveraging its financial sector, Luxembourg has established a Space for Finance initiative together with the European Investment Bank. As a result, the country consolidates its position as both an innovation hub and an investment hub within the European space sector.

1.5. Problems of Applying the Luxembourg Model of Space Resource Utilization by China

In his study, K. J. Bradford emphasizes that Luxembourg's model is based on commercial orientation, legislative transparency, international openness, and the stimulation of high-technology investment. This approach enables states without substantial public funding to develop their own space sectors by supporting private enterprises. A prominent example is Luxembourg, where a special law was enacted guaranteeing private companies the right to own resources extracted from celestial bodies – an unprecedented legal innovation worldwide. According to Bradford, such a model may be adapted by other states through the implementation of similar legislation, especially those aiming to attract foreign companies and capital (Bradford, 2018).

The provisions of Luxembourg's legislation on space resources have played a pioneering role for other states seeking to legalize property rights to extracted materials in outer space. Although the Luxembourg law does not provide a strict definition of "space resources," it relies on the U.S. understanding of the concept, which covers inanimate resources in space. Unlike the United States, which avoids the term "appropriation," the Luxembourg act openly recognizes

ownership rights over extracted resources. The law requires companies to obtain authorization before commencing such activities, and applicants must satisfy reliability criteria. Luxembourg's experience demonstrates that states can shape the future of international space law through domestic legislation that explicitly recognizes commercial exploitation of outer space. The 2021 Japanese Space Resources Act likewise permits appropriation after extraction, though it uses a more general definition of natural resources, leaving room for broad interpretation. The United Arab Emirates, in turn, adopted legislation that does not explicitly mention appropriation but includes space mining among authorized activities (DePager, 2021).

As is often the case in the confrontation between democracies and authoritarian regimes, the latter can adapt more swiftly in the short term to changing conditions. In January 2018, during an official visit to Beijing, Luxembourg's Deputy Prime Minister Étienne Schneider signed a Memorandum of Understanding with the China National Space Administration (CNSA) on the peaceful exploration of outer space. This significantly altered the situation. Combined with Luxembourg's liberal space legislation, the agreement created a hybrid legal framework, where not only private companies from other countries entered the Luxembourg market but also, to some extent, state institutions of China. The MoU established a framework for scientific, technical, economic, and political cooperation in the field of space resource utilization. At the same time, an agreement was signed with the National Space Science Center of the Chinese Academy of Sciences to establish a Deep Space Research Laboratory in Luxembourg. This laboratory, as an independent legal entity, was tasked with conducting scientific research and technological development, particularly within the framework of the SpaceResources.lu initiative (Luxembourg, 2018b).

The full official text of the MoU between Luxembourg (Ministry of the Economy) and CNSA has not been published in open sources. However, several secondary accounts allow for an approximate understanding of its content. For example, the official website of Luxembourg's Trade and Investment Office in Shanghai reported on the document "Luxembourg and China Cooperate in Space Exploration" dated February 8, 2018. According to this source, the MoU laid the foundation for peaceful, non-financial cooperation in outer space exploration and utilization. The parties agreed to collaborate in technical, economic, scientific, and regulatory fields. Luxembourg consistently promotes the SpaceResources.lu initiative, in which China has emerged as one of the key potential partners. Within this agreement, the Deep Space Research Laboratory was established in Luxembourg (Luxembourg, 2018b).

It is emphasized that scientific cooperation between Luxembourg and China is not limited to technical aspects. Both parties agreed to provide mutual support in developing political and economic frameworks for space partnerships. In this regard, Luxembourg seeks to establish itself as a global legal hub for space resource utilization. Its policy is based on openness to foreign investors and a liberal regulatory approach, while China, for its part, gains access to European scientific and technological markets. In the long run, this cooperation was expected to pave the way for joint launch programs, telemetry, and data analysis. Notably, Luxembourg consistently avoids confrontational strategies in international space relations (Luxembourg, 2018b).

The educational and scientific dimension of the partnership also deserves particular attention. Luxembourgish universities, especially the University of Luxembourg, have already begun collaboration with Chinese research institutions. Joint research projects, graduate exchanges, conferences, and summer schools in aerospace engineering have been launched. This enhances workforce training and produces a new generation of engineers familiar with both European and Chinese contexts. Chinese students acquire experience in the European environment,

while Luxembourgish students and faculty gain access to the advanced laboratories of the Chinese Academy of Sciences. Both sides are also engaged in multilateral space initiatives: China actively participates in BRICS, SCO, and the “Belt and Road” space initiative, while Luxembourg remains integrated within European Space Agency programs, where Chinese involvement is limited.

Not surprisingly, such cooperation has faced criticism from the United States. Congressional reports explicitly warn that China sees space not only as a scientific field but also as a potential arena for power projection. Washington is especially concerned by China’s comparisons between the Moon or Mars and disputed maritime areas in the South China Sea, which suggest a possibly aggressive view of sovereignty in outer space. Additionally, China’s strategy of “civil-military fusion” blurs the lines between scientific, commercial, and military uses of space technology. This fuels U.S. worries about China’s true goals for its space programs. Concerns in Washington also arise from China’s use of legal and semi-legal methods to bypass U.S. export controls, such as leasing or collaborating on commercial satellites through third countries. Congressional reports highlight that even Europe’s officially neutral involvement in joint projects with China may inadvertently give Beijing access to advanced Western technologies (U.S.-China, 2019).

1.6. Problems of Luxembourg’s Model and Its Use by China in the Context of the Russia–Ukraine War

In June 2023, the Director of the Luxembourg Space Agency, Mathias Link, speaking at the Secure World Foundation summit in New York, declared Luxembourg’s ambition to act as a mediator between the United States and China in the field of space cooperation. He emphasized that, despite geopolitical tensions, Luxembourg remains committed to sustaining dialogue with Chinese space institutions, building on the 2018 Memorandum of Understanding with CNSA. Link stressed that openness to investors and the pursuit of intergovernmental cooperation provides small states such as Luxembourg with a strategic advantage. At the same time, U.S. representatives criticized China for a lack of transparency in space affairs. Nonetheless, Luxembourg continues to view international collaboration as essential to the success of new commercial space initiatives (Luxembourg, 2023).

Within the framework of China’s expanding global diplomatic activism, the People’s Republic of China has been intensifying its space partnerships with various countries, including Luxembourg. In this context, Chinese commercial satellite companies tied to the defense-industrial complex, such as the Changsha Tianyi Space Science and Technology Research Institute (Spacety China), have used overseas subsidiaries in Europe – particularly in Luxembourg – as cover for military-oriented transfers. Operating from Luxembourg, these companies reportedly supplied high-resolution satellite imagery of Ukrainian territory to Russian structures. According to U.S. and European reports, this data was subsequently used by the Wagner Group in its combat operations against Ukraine. Such activities, carried out by a Chinese company and its Luxembourg-based affiliate, have alarmed the international community as they pose risks of sanction violations against Russia and tarnish Luxembourg’s image as a transparent and peaceful space jurisdiction (U.S.-China, 2023).

In the context of the Russia–Ukraine war, U.S. experts K. Pollpeter, E. Barrett, D. Edmonds, and others have drawn attention to the growing strategic alignment between China and Russia in outer space. They underline that Sino-Russian space cooperation reflects a broader geopolitical partnership, which has deepened as both countries’ relations with the United States have deteriorated. While Russia historically dominated space exploration, today the

initiative is increasingly shifting to China, which possesses steady funding and an expanding technological base. The partnership encompasses military, scientific, economic, and diplomatic dimensions. Special emphasis is placed on joint developments in missile defense, navigation, satellite reconnaissance, and lunar exploration. The formalization of numerous agreements from 2013 to 2022 demonstrates the intent of both parties to strengthen trust and technological interdependence. In particular, Russia has provided China with access to sensor technologies that improve its missile-tracking capacity, as well as transferring expertise in developing powerful rocket engines such as the RD-180 (Pollpeter, et al., 2023).

Put differently, a dangerous legal chain is emerging. By engaging with Luxembourg under its liberal legal framework – whether through its “private” space companies or directly via state institutions – China effectively legitimizes itself within the European Union and other Western jurisdictions. Yet, in practice, many Chinese space companies are likely to be subject to significant state influence or control. Consequently, the technological expertise acquired in Europe may be transferred to Russia. This creates a legal and geopolitical paradox: Luxembourg’s open model, designed to attract foreign investment and foster innovation, may inadvertently facilitate the strategic military-technological alignment between China and Russia.

Conclusions

Luxembourg’s space legislation has created an innovative legal framework that paves the way for private property rights over resources mined in outer space. The 2017 Law on the Exploration and Use of Space Resources was the first European law to officially recognize private ownership of resources extracted from asteroids. This law has helped Luxembourg attract foreign companies and host multiple commercial missions within its jurisdiction. It aligns with international space law principles, especially the 1967 Outer Space Treaty, while intentionally avoiding accession to more restrictive international agreements. Its implementation is supported by the LuxIMPULSE program, ESRIC, and the Luxembourg Space Agency (LSA), which handles licensing and oversight.

China has sought to take advantage of Luxembourg’s openness to strengthen its presence in the European space sector, particularly following the 2018 Memorandum of Understanding signed with the China National Space Administration. This agreement envisaged the peaceful use of outer space, the establishment of a Deep Space Laboratory in Luxembourg, and the initiation of strategic cooperation within the SpaceResources.lu program. The laboratory functions as a separate legal entity, with priorities in interplanetary communications and deep space exploration. In addition, academic exchanges, joint educational programs, and conferences with universities have facilitated opportunities for Chinese experts to engage with the European scientific and technological community.

Nevertheless, Luxembourg’s cooperation with China has raised potential security concerns and questions regarding sanction compliance. This became especially apparent in the activities of Spacety’s Luxembourg subsidiary, which, according to U.S. intelligence assessments, may have transferred satellite imagery of Ukrainian territory to Russian entities that was reportedly used by the Wagner Group. Such cases illustrate vulnerabilities in existing safeguards against dual-use technologies. Despite commitments to peaceful collaboration, Luxembourg’s open legal framework has, at times, been perceived as a possible conduit for sensitive technologies entering conflict zones, prompting calls for stronger oversight mechanisms (U.S., 2023).

Luxembourg officially maintains neutrality and openness, yet in practice functions as a platform for dialogue between global rivals – the United States and China. LSA Director Mathias Link has emphasized the country's ambition to act as an intermediary in fostering space cooperation even amidst geopolitical confrontation. At the same time, U.S. officials have voiced concerns about the transparency of Chinese programs and the potential for technology control regimes to be circumvented. Luxembourg's jurisdiction is increasingly viewed as a potential entry point for Chinese companies – including those with unclear ownership structures – into the European market. This dynamic creates tension between legal liberalism and security commitments vis-à-vis NATO partners, requiring Luxembourg to carefully balance economic opportunity with strategic trust.

Luxembourg's space law has therefore become not only an instrument of innovation but also a framework that may inadvertently provide a pathway for China's growing role in space within the Western legal order. Through its liberal legislative base, Chinese companies – some of which are believed to be under significant state influence – have been able to register as private actors in Luxembourg. This development has positioned China as a more visible participant in commercial space activities. At the same time, there are credible concerns that knowledge, expertise, and technologies acquired in Europe could ultimately be shared with Russia under the framework of Sino-Russian partnerships, heightening security risks for Ukraine and the wider European environment. Consequently, Luxembourg's open model, while innovative, underscores the importance of creating an international regime for monitoring dual-use technologies and ensuring adherence to the principles of the peaceful use of outer space.

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