Analysis of the Situation of Foreign Aerospace Legislation and International Rules and Its Implications

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Abstract: Against the backdrop of the rapidly evolving international landscape and the increasingly intense competitive game between China and the United States, aerospace, as a critical domain related to a country's strategic interests, international status, scientific and technological development, and industrial transformation, faces more urgent development needs and a more complex development situation. This paper mainly takes major aerospace powers in the world such as the United States and Europe as examples, conducts research on aerospace legislation, and explores various aspects of concern regarding international rules for commercial aerospace, so as to provide support for China in building a legal system for commercial aerospace. Finally, based on China's national conditions, the paper analyzes the main gaps and shortcomings in China's aerospace development, and puts forward measures and suggestions for accelerating the legislation to build China into an aerospace power.

Keywords: Aerospace Legislation; International Rules; National Strategy; Commercial Aerospace; Aerospace Treaties

1. Introduction

With the increasingly fierce competition among major powers, outer space has gradually become a new battlefield for technological rivalry. Major aerospace powers such as the United States, Europe, and Russia have witnessed rapid and continuous development in the aerospace field, attracting widespread attention worldwide. In recent years, commercial aerospace has emerged from traditional aerospace, and a large number of commercial aerospace companies —including SpaceX, Blue Origin, and OneWeb—have emerged one after another, exerting their strengths in fields such as launch vehicles, satellites, and space exploration [1]. Meanwhile, many countries have enacted policies and regulations on commercial aerospace, which serve as a guarantee and constraint for ensuring the long-term stability of commercial aerospace and the rational and effective utilization of space resources. From a national perspective, the United States has achieved the most comprehensive and mature development in commercial aerospace: from top-level legislation to guiding procurement at the government level, then to the establishment of division of labor and cooperation among enterprises, and the participation of venture capital institutions, it has formed a self-sustaining commercial aerospace industry ecosystem [2].

Compared with the United States, China's commercial aerospace started relatively late. While traditional aerospace has achieved leapfrog development under the leadership of the whole-nation system, hundreds of commercial aerospace companies have also emerged in China amid the global wave of commercial aerospace. However, China has not kept pace with the development of commercial aerospace in terms of commercial aerospace strategy, legislative policies, qualification access, resource sharing, and talent flow. This has led to phenomena such as competition between commercial and traditional aerospace, non-standardized industry practices, and blocked talent flow channels.

It can be seen from this that accelerating the formulation of aerospace legislation is an essential guarantee for safeguarding China's status as a major aerospace country and peacefully developing outer space resources; it is an inevitable requirement for aligning with international laws and regulations and enhancing China's national discourse power; and it is also a necessary means to promote the development of the aerospace industry and advance military-civilian industrial integration. This study systematically sorts out the types and

current status of commercial aerospace legislation in major foreign countries, aiming to provide suggestions and support for China's commercial aerospace legislation.

2. Aerospace Legislation in Major Foreign Countries

Most countries in the world have relatively similar aerospace law frameworks, which can be roughly categorized into several types. First, top-tier laws—referring to fundamental aerospace laws that provide a basic legal framework for a country's overall aerospace activities, such as the United States' National Aeronautics and Space Act. Second, aerospace activity-specific laws—enacted to clarify the regulatory authorities for aerospace activities or the specialized institutions directly engaged in aerospace activities, such as the U.S. Commercial Communications Satellite Act and Commercial Space Launch Act. Third, various systems—designed to safeguard all tasks and links in commercial aerospace, including licensing systems, liability and insurance systems for space activities, and export control systems. Among these countries, the United States and Europe have relatively well-developed commercial aerospace legislation, which is worthy of in-depth research and analysis [3-5].

2.1 U.S. Commercial Aerospace Policies and Regulations

U.S. commercial aerospace ranks among the top in the world, and its rapid development benefits from the country's relatively sound aerospace policy system.

First, it is driven by national top-level strategies and laws. Since 1958, the United States has issued and gradually refined the National Aeronautics and Space Act, which clarifies the relationship of military-civilian sharing in aerospace and provides a legal basis at the national top level for emerging commercial aerospace forces to participate in the development of aerospace equipment and promote the integrated development of military, civilian, and commercial aerospace. Documents such as the National Space Strategy (2018), Space Strategy (2020), and U.S. Space Priorities Framework (2021), successively released by the U.S. White House and the Department of Defense, all emphasize maximizing the mobilization and procurement of commercial aerospace capabilities.

Second, it is driven by specialized policies for key areas of commercial aerospace. The United States has issued laws, regulations, and strategies in key fields such as launch services, remote sensing, navigation, space situational awareness, and space traffic management to promote the coordinated development of commercial aerospace across different domains. For example, in terms of space launches, the Commercial Space Launch Competitiveness Act (2015) grants private companies various rights to exploit space resources; in the field of remote sensing, the Commercial Geospatial Intelligence Strategy (2016) encourages commercial companies to provide better remote sensing intelligence to the government and integrates commercial forces into military services and arms; in the navigation field, the Space-Based Positioning, Navigation, and Timing Policy (2021) encourages privately operated PNT (Positioning, Navigation, and Timing) services. Meanwhile, the U.S. government coordinates the relationship between the military and commercial sectors, clarifies the division of responsibilities and coordination among various military, civilian, and commercial aerospace management departments, and ensures the coordinated and steady advancement of aerospace capability development among all parties.

The U.S. commercial aerospace policies and regulations maintain a mutually reinforcing relationship with large commercial aerospace companies such as SpaceX and Blue Origin: the policies and regulations promote the healthy development of the industry, while industry practices in turn influence the formulation and adjustment of policies and regulations [6-7].

2.2 European Commercial Aerospace Policies and Regulations

The management of commercial aerospace in Europe is based on integrated cross-border aerospace industry management and aerospace industry management by national government agencies. Therefore, the development of commercial aerospace in European countries must comply with dual legal frameworks.

First, development under Europe's overarching commercial aerospace policies and regulations. This regulatory system is formulated and implemented by organizations such as the European Space Agency (ESA) and the

European Union (EU), and it safeguards the collective interests of EU member states. The system includes documents such as the European Space Policy (2003), the EU Space Programme (2021), and the European Space Strategy in a Global Context (2020). In August 2021, the ESA proposed five key priorities for the period up to 2025, one of which is "advancing commercialization." This priority outlines the ESA's commitment to enhancing engagement with start-ups, supporting the success of commercial aerospace enterprises, enabling European aerospace companies to rank among the world's top-tier enterprises, and driving the rapid growth of the green and digital economies. The strategy also proposes measures such as the ESA acting as a technical partner to engage with investors (including venture capital and angel investment) and supporting the development of a space technology market that serves the building of a green and digital Europe.

Second, development under the national commercial aerospace legal systems of individual European countries. Europe comprises numerous countries; take the United Kingdom as an example. In 2015, the UK Space Agency released its first National Space Policy, which aims to achieve the goal of "accounting for 10% of the global aerospace economy by 2030." The policy stipulates that the dual-use (military and civilian) demands of aerospace should be coordinated through cross-departmental and cross-industry collaboration, financial markets should be leveraged to serve commercial aerospace enterprises, and the capabilities of commercial aerospace should be enhanced. In terms of strategy, in 2021, the UK's Department for Business, Energy and Industrial Strategy (BEIS) and the Foreign, Commonwealth & Development Office (FCDO) jointly released the UK's first National Space Strategy. This strategy articulates the vision of making the UK one of the world's most innovative and attractive aerospace economies, and puts forward strategic orientations such as supporting enterprises in developing new commercial opportunities and building a nationwide aerospace industry ecosystem. In 2023, the UK government issued the National Space Strategy Action, which outlines the pathways for commercial aerospace to unlock growth and conduct international cooperation.

The development of commercial aerospace enterprises in Europe is highly competitive. Once the space agencies of France, the United Kingdom, Germany, and Italy identify aerospace projects with commercial potential, they encourage research institutions to transfer these projects to private enterprises for commercial development and promotion in domestic and international markets. In recent years, enterprises in the European commercial aerospace sector have ceased to be passive "recipients" of government space programs; instead, they are gradually becoming "partners." New commercial aerospace companies and commercial space programs have also emerged one after another.

3. International Rules for Commercial Aerospace

International aerospace regulations refer to mandatory international rules that regulate the activities of countries and their citizens in outer space and on other celestial bodies. Their legal scope covers space sovereignty, space resources, space environment, space transportation, space liability, space arms control, space remote sensing, and other areas, as shown in Figure 1.

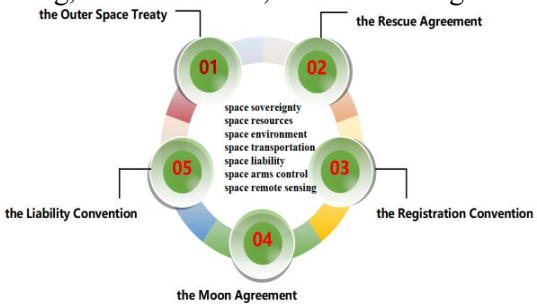

Figure 1. The Five Major International Aerospace Treaties

Currently, the top-tier framework consists of five international treaties promulgated by the United Nations—the Outer Space Treaty, the Rescue Agreement, the Liability Convention, the Registration Convention, and the Moon Agreement [8-10]—among which the Outer Space Treaty serves as the foundation of international rules for commercial aerospace, and the five instruments interact and complement each other. The Outer Space Treaty, also known as the "Constitution of Space," stipulates 10 fundamental principles for aerospace activities and is crucial for countries to explore and use outer space peacefully; the Rescue Agreement, an international instrument defining countries' rights and obligations in

space rescue, mandates that any contracting party provide all possible assistance to rescue spacecraft personnel landing within its territory, whether due to accident, distress, emergency, or unintended landing; the Liability Convention establishes effective international rules and procedures for liability arising from damage caused by space objects, helping protect member states' space assets and promote peaceful coexistence; the Registration Convention requires launching states to register space objects and notify the Secretary-General of the United Nations of the establishment of such registries; and the Moon Agreement, applicable to the Moon and other celestial bodies in the solar system, mandates that these celestial bodies be used for the benefit of all countries and peoples of the international community and prevents the Moon from becoming a source of international conflicts.

Beyond these five major international aerospace treaties, commercial aerospace activities must also comply with various United Nations rules, including the Principles Governing the Use by States of Artificial Earth Satellites for International Direct Television Broadcasting (1982), the Principles Relating to Remote Sensing of the Earth from Outer Space (1986), the Principles Relevant to the Use of Nuclear Power Sources in Outer Space (1992), and the resolution on the Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries (1996).

Commercial aerospace involves numerous elements related to outer space security, such as requirements for space debris mitigation, on-orbit collision avoidance, space situational awareness, notification and reporting of aerospace incidents, and emergency response mechanisms and principles. Among these, the issue of space sustainability has become a focal point of debate among countries: currently, major powers including the United States, Canada, the United Kingdom, and France primarily advocate for the implementation of existing guidelines that reflect their own technologies and practices and are unwilling to negotiate new guidelines, while China, Russia, Brazil, and Switzerland advocate for effectively addressing the challenges to the long-term sustainability of outer space activities, and the working group has consolidated the views of both sides and decided to adopt a "phased approach" to formulate relevant rules. In addition, the management of large satellite constellations has also become an issue of international concern—against the backdrop of the rapid deployment of constellations by commercial aerospace companies such as Starlink, Russia has questioned that large satellite constellations provide battlefield intelligence and participate in military conflicts (a practice clearly inconsistent with the purpose of peaceful use of outer space); Iran has condemned that such constellations provide internet services without government permission, infringing on cyber sovereignty, interfering in internal affairs, and violating international law; Chile and South Africa have raised concerns that excessive brightness of constellation satellites affects astronomical observations; Germany, France, and Switzerland have pointed out that the excessive number of constellation satellites exacerbates low Earth orbit congestion and involves legal issues such as space object registration. In the future, the international policy trend toward commercial aerospace will tend to tighten, and coupled with the limited nature of orbital resources, only by accelerating development can a country seize the initiative among other nations.

4. Implications for China's Aerospace Development

Compared with the international community (especially the United States and Europe), China's aerospace regulatory system remains incomplete and thus struggles to adapt to the current dynamic commercial aerospace activities. Therefore, it is urgent to establish an aerospace regulatory system in line with China's national conditions—accelerating the enactment of China's Aerospace Law, formulating specialized regulations for commercial aerospace, improving subordinate laws such as policies and regulations in specific fields, and actively participating in the formulation of international aerospace rules—to promote the standardized and orderly development of China's aerospace industry [11-14], as shown in Figure 2.

4.1 Accelerating the Enactment of Top-Tier Laws

The fundamental aerospace law (as the "cornerstone law" of the aerospace legal system)

serves as the fundamental basis for formulating aerospace regulations, rules, and other management norms. China is the only major aerospace country without a dedicated aerospace law, so it should expedite the legislative process of the Aerospace Law, clarify the relationship between the Aerospace Law and existing laws/regulations, and establish the foundation and framework for aerospace legal construction. It is also necessary to strengthen full-process supervision of aerospace activities, covering key links such as the management of aerospace research, production, testing, storage, and transportation; management of major special projects; sales and use of aerospace products; transfer of aerospace technologies; launch permits; on-orbit operation supervision; re-entry management; space object registration; permits for on-orbit transfer of space objects; import and export control of aerospace products and technologies; and supervision and inspection of aerospace activities.

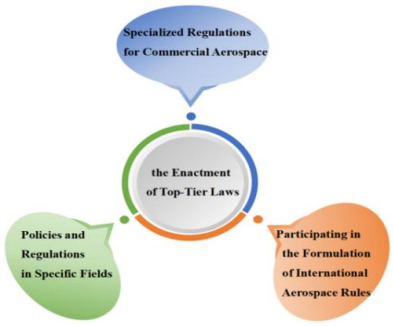

Figure 2. Aerospace Regulatory System

4.2 Formulating Specialized Regulations for Commercial Aerospace

First, guided by top-tier legal leadership, China should incorporate commercial aerospace development capabilities into the national overall aerospace plan, take market-oriented resource allocation as the direction, and build an advanced, standardized, and comprehensive legal system that aligns with the actual development of China's commercial aerospace. It is essential to establish mechanisms for commercial aerospace, including market access and exit, fair competition, insurance and compensation, and safety supervision; formulate detailed implementation rules for policies such as import and export license systems for commercial satellites, rockets, and other products, commercial rocket launch permits, and commercial satellite frequency permits; and improve policies related to asset securitization for commercial aerospace. By building a relatively complete legal and regulatory system for commercial aerospace, China can accommodate, encourage, and promote the development of new formats and models in the commercial aerospace sector.

4.3 Improving Policies and Regulations in Specific Fields

China should improve policies on the use, management, sharing, distribution services, and sales of domestic remote sensing satellite data, formulate policies on declassification and resolution reduction of high-resolution data, and reasonably allocate shutter control rights for high-resolution commercial remote sensing satellites; it should also establish a market access system for foreign satellite data, encourage priority use of domestic satellite data in fields such as government administration, public welfare information services, education, and publicity, promote market-oriented development of application technologies and software for domestic satellites, and stimulate the enthusiasm of social users in utilizing domestic data. Additionally, China needs to revise the Regulations on the Administration of Satellite Television Broadcasting Ground Receiving Facilities (referred to as "Document No. 129") and appropriately relax restrictions on satellite communications: Document No. 129 has been in effect for nearly 30 years, and significant changes have occurred in current satellite communication technology levels, the international environment, and development needs—especially after the launch of the Belt and Road Initiative, China faces an urgent need to provide high-quality satellite communication services to countries along the routes. However, relevant provisions in Document No. 129 (such as those on the production and sales of satellite ground receiving facilities) can no longer meet the development needs of the current satellite communication industry, so it is recommended to conduct a comprehensive assessment of the current development environment, development needs, and technical status, and make adaptive adjustments to Document No. 129 to remove obstacles to the development of the satellite communication industry. Furthermore, China should accelerate legislation on emerging space activities to standardize and promote the development of commercial aerospace: in recent years, new space activities represented by space

tourism and asteroid mining have developed rapidly, and countries such as the United States, Japan, and Luxembourg have already carried out legislation in relevant fields. At present, China still has a gap in legal norms for new outer space activities, and existing normative documents cannot meet the needs of fulfilling obligations under international treaties, safeguarding national security, and standardizing commercial aerospace activities. It is therefore suggested that China attach importance to researching legislation on emerging space activities such as the utilization of extraterrestrial planetary resources and asteroid mining, and use legal means to guide and regulate entities (such as enterprises) in investing capital, technology, and human resources in emerging fields for research and engineering exploration.

4.4 Actively Participating in the Formulation of International Aerospace Rules

National space security is an important component of national security, covering the security of space assets and the safety of aerospace activities. Currently, China lacks special provisions for protecting national space assets, so it is urgent to protect the security of space assets through legislation—especially by issuing special provisions on the jurisdiction over space assets, clarifying the conditions and composition of such jurisdiction, and defining the main responsibilities for space debris mitigation and removal. China should rationally regulate space activities to the greatest extent possible under the established rules of international space law to effectively promote the development of aerospace activities; at the same time, it should actively guide the formulation of international rules to protect the legitimate rights and interests of China’s aerospace activities and safeguard national interests and national security.

5. Conclusion

The rapid development of China's space industry urgently requires space legislation. By studying the space legislation of major space powers in the United States and Europe, as well as international rules for commercial space, it can provide support for China to establish a space legal system. China should accelerate the introduction of top-level laws, formulate specialized regulations for commercial space, improve policies and regulations in specific fields, and actively participate in the formulation of international space rules, thereby better promoting the development of China's space industry.

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