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Comparative Analysis of Sensitive Space Technology Regulations in Asean Countries

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Abstract

Space technology has rapidly evolved due to technological advancements, emphasizing the need for regulatory attention. This paper examines the regulation of sensitive space technology across ASEAN countries through a comparative analysis. Sensitive space technology, a high-stakes field crucial for conducting space activities, requires regulation due to the boundless nature of space. Typically, the regulation of space activities is established within international law, while specific national laws govern these activities in countries actively engaged in the space sector. The research adopts a descriptive qualitative methodology, utilizing literature reviews as the primary data source. This research aims to explore and compare the regulatory frameworks for sensitive space technology in ASEAN countries. This analysis could serve as a guide or benchmark for Indonesia as it develops national regulations on sensitive space technology. The findings reveal that Indonesia has enacted a Space Act dedicated to the space sector. Malaysia similarly regulates its space activities through a Space Act and accompanying Space Regulations. While lacking a specific law for sensitive space technology, Singapore manages these activities under existing legislative frameworks.

A. Introduction

Space law is experiencing rapid changes due to technological advancements, particularly in deploying space objects. These advancements present opportunities and challenges; while

wealthier nations with space technology can conduct operations across national airspace more easily, this may pose security risks to other countries.[1] Moreover, space technology helps global populations become more aware of their living conditions and introduces sustainable solutions.[2] The Outer Space Treaty of 1967, which outlines the rights and responsibilities of nations in space, serves as the foundation for countries with space capabilities to develop national regulations on specific activities, especially those involving sensitive technologies. These technologies, crucial due to their potential offensive and defensive applications, include nuclear, cyber (Information and Communications Technology, or ICT), and aerospace technologies, each reshaping global dynamics in distinct ways.

Nuclear technology generates over 17% of the world's electrical power through nuclear reactors and has transformative potential due to its mass destruction capabilities.[3] Cyber technology erases traditional geographical and temporal boundaries, revolutionizing international interactions. Aerospace technology significantly reduces travel times, and space technology more broadly alters our interactions with the cosmos. Additionally, the advent of cyber technology, central to Industry 4.0, transforms production and manufacturing through digital innovation. This includes merging the digital and physical realms with technologies such as the Internet of Things (IoT), mobile solutions like smartphones and wearable sensors, cloud computing for cost-effective data storage and processing, cyber-physical systems for enhanced control and monitoring, big data analytics, and advanced manufacturing technologies like robotics and 3D printing.[4]

This legal research employed normative research methods and utilized secondary qualitative data. It incorporated both primary and secondary legal documents. International treaties were considered primary legal documents, while expert opinions collected from various sources constituted the secondary legal materials. This research analytically described the rules and conditions governing using force under international law. Furthermore, it explored the ethical and legal ramifications of using force against civilian aircraft globally.

B. Discussion

1. ASEAN Sensitive Technology Regulations in Comparative Perspective

The concept of space-sensitive technologies in international law pertains to technologies associated with exploring, developing, and utilizing outer space that are crucial for strategic and national security purposes. The space sector is integral to communications, Earth monitoring, global navigation, and potentially military applications. Consequently, nations regard space technology as sensitive and necessitate its regulation through international law.[5] The following are the international legal instruments that relate to outer space:

1. *Outer Space Treaty 1967*: The Outer Space Treaty, formally known as the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, established in 1967, provides guidelines for using space that must adhere to noble objectives to maintain peace. This treaty outlines the principle of peaceful use of outer

[1] Amadea Nurul Auliarahma, Harold Anis & Stefano O. Vegas, 2021, Pengaturan Pemanfaatan Ruang Angkasa Menurut Perjanjian Internasional Space Treaty 1967, *Lex Administratum*, 9(7), P. 91.

[2] Harijono Djojodihardjo. (2015). Space Terminology, Space Technology Imperative and Sociocultural Environment Heuristic Model. *International Journal of Modern Communication Technology & Research* (IJMCTR). 3(3). P. 6.

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[4] Abd Rahman Abdul Rahim & Robiah Ahmad, 2018, Information and Communication Technology in Industry 4.0, Tech Target, E P. 3.

[5] Runggu Prilia Ardes, "standar pengaturan pelindungan teknologi sensitif keantariksaan internasional : implementasi di indonesia," *Jurnal Bina Mulia Hukum* 5, no. 25 (2020): 15–35.

space and prohibits the deployment of nuclear weapons in space. It also stipulates that states must assume responsibility for their national space activities.[6] Article 2 of the Outer Space Treaty also specifies that while a nation may retain jurisdiction over objects or satellites, it launches into space, no individual or nation can claim ownership of outer space.

2. *The Rescue Agreement,* formally known as the "Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space," is an essential part of the international legal framework for space activities. This international treaty, which came into force in 1968, outlines the responsibilities of states in rescuing astronauts who encounter emergencies during space missions and returning astronauts and space objects back to their originating countries.[7]
3. *The Liability Convention is officially* known as the "Convention on International Liability for Damage Caused by Space Objects.
   The Liability Convention, formally known as the "Convention on International Liability for Damage Caused by Space Objects," is an international treaty that came into effect in 1972. It governs the liability of states for damage caused by space objects launched from their territory. This treaty extends the principle of state accountability established in Article 6 of the 1967 Outer Space Treaty. Under the Liability Convention, states are mandated to accept responsibility for their space activities and address any resultant damages. This framework ensures that states take necessary measures to protect individuals and property that might be adversely affected by such activities, reinforcing the liability principle in international space law.[8]
4. *Registration Convention*. The Convention on Registration of Objects Launched into Outer Space, often called the Space Object Registration Convention, is an international treaty adopted by the United Nations in 1974 and came into force in 1976. The primary purpose of this convention is to establish an international system for the registration of space objects.
5. *The Moon Agreement,* also known as the Agreement Governing the Utilization and Exploration of Natural Bodies on the Moon and Other Natural Bodies (Agreement Governing the Activities of States on the Moon and Other Celestial Bodies), is an international treaty designed to regulate human activities on the Moon and other celestial objects beyond Earth. The United Nations General Assembly adopted the treaty in 1979 and entered into force in 1984.

The concept of space technology in international law also includes various aspects, such as:

1. Protection of the Space Environment

International law also regulates the protection of the space environment, including space waste management and preventing space pollution from ensuring that the exploration and use of outer space are carried out with due regard for environmental sustainability and to maintain the sustainability of space activities.

2. Space Law Enforcement

International law includes mechanisms for enforcing rules related to space activities. If a country violates international regulations concerning the use or exploration of outer space, other nations or international organizations have the authority to take appropriate legal actions to enforce compliance and address any breaches.

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[6] Paul G Dembling and Daniel M Arons, "The Evolution of the Outer Space Treaty," *Documents on Outer Space Law*, 1967.
[7] Mahima Singh, "Space Tourism and The Rescue Agreement," *Dissertation, College of Legal Studies, University of Petroleum and Energy Studies Dehradun* (2015).
[8] Guoyu Wang and Chao Li, "Applicability of the Liability Convention for Private Spaceflight," *Space: Science & Technology* 2021 (2021), https://doi.org/10.34133/2021/9860584.

3. Space Arms Control Regimes
   Some countries are working to develop effective space arms control regimes to avoid an arms race in space. The aim is to prevent the spread of space weapons that could threaten international stability and peace.
4. Access and Openness
   Some countries also encourage access and transparency in space activities, including sharing scientific data, research results, and technical information related to space. This aims to facilitate international cooperation, add to the body of knowledge, and the peaceful use of space technology.

The significance of space-sensitive technologies in international law lies in its role in preserving stability and security in outer space. The main objectives are to prevent an arms race in space, safeguard the space environment, and ensure that space exploration and usage proceed peacefully and orderly, consistent with established principles of international law. Space-sensitive technologies encompass a variety of critical systems and devices, including:[9]

1. Rockets and Launchers
   Launch technology is one of the most fundamental space exploration vehicles for carrying spacecraft and satellites to a specific orbit or space destination.
2. Spacecraft
   Spacecraft, crewed probes, and uncrewed spacecraft are essential in space exploration. They integrate advanced technology such as propulsion, navigation, and maneuvering systems to enable probes to reach their destinations.
3. Satellites
   Satellites orbit the Earth or other planets for communication, weather monitoring, mapping, and scientific research. Space-sensitive satellite technologies include communication systems, imaging instruments, and orbiting systems.
4. Mission Control Systems
   Mission control systems are technologies used to control and monitor spacecraft during flight. This includes navigation systems, computer systems, and other hardware and software required to control the vehicle with high accuracy and reliability.
5. Earth Monitoring Technology
   This technology is used for Earth monitoring from space, including weather monitoring, environmental mapping, and natural resource monitoring. It involves using optical instruments, radar, and other sensors to collect data about our planet.
6. Living and Life Support Systems
   In long space missions, such as missions to Mars, life support system technologies such as water purification systems, waste treatment, oxygen provision, and food provision for astronauts are important.
7. Space Robotics
   Space robotics refers to using robots and uncrewed vehicles to carry out tasks in space for planetary surface exploration, spacecraft repair, and other scientific research.
8. Radiation Protection System
   During long-distance space travel, astronauts are exposed to high radiation levels that require radiation protection technology, which involves effective radiation shielding and monitoring systems.
9. Commercial Spaceflight Technology
   Mastering these technologies can offer strategic and national security benefits to countries that excel in their development and application. Recognizing this, nations acknowledge the need to regulate the transfer, development, and usage of space

[9] Dembling and Arons, "The Evolution of the Outer Space Treaty."

technologies to uphold international security and stability and prevent their exploitation by states with malicious or detrimental intentions. Countries cooperate through treaties, control regimes, and multilateral frameworks to manage sensitive space technologies effectively. These efforts aim to ensure the peaceful use of outer space, prevent a space arms race, and guarantee that space technologies are utilized responsibly and in compliance with relevant international legal standards.

In addition to the countries mentioned earlier, nations like France, Germany, the United Kingdom, Canada, Japan, and many others have established regulations and legal frameworks concerning space-sensitive technologies. These are implemented in alignment with their national security interests and international obligations.

On the other hand, the ASEAN (Association of Southeast Asian Nations) member states have not yet developed a unified regulatory framework specifically for space-sensitive technologies. However, some ASEAN countries have enacted national regulations concerning these technologies tailored to their individual interests and policy objectives. Examples of ASEAN countries with such national regulations include:

1. Indonesia

Indonesia has enacted national laws governing space activities, prominently featuring Law Number 21 of 2013 on Space. This comprehensive legislation addresses various aspects of space technology, including the transfer, intellectual property protection, and international cooperation of space technologies. Although the law does not explicitly define "sensitive technology," it incorporates it under Article 27 in the fourth section, which pertains to the control of space technology. This article ensures the security of sensitive space technologies imported into Indonesia, emphasizing peace, national interests, and fulfilling international obligations. Details regarding the procedures and mechanisms for securing sensitive space technology are further elaborated in subsequent Government Regulations.

Law Number 21 of 2013 serves as the primary legal framework for space activities in Indonesia, with specific articles that provide security guarantees and outline standards and procedures for safety and security. These provisions are mandated to be detailed further in Government Regulations.

The term "sensitive technology" within the context of this law refers to technology associated with the equipment or types of technology used in the development of space probes. In addition to Law No. 21 of 2013, the framework of Indonesian space law includes several other regulations, such as a Draft Government Regulation (RPP) concerning the construction and operation of spaceports. Moreover, Indonesia has ratified international agreements through the Presidential Decree of the Republic of Indonesia Number 20 of 1996, which adopts the 1972 Liability Convention, and Government Regulation Number 11 of 2018, that governs the Procedures for Implementing Remote Sensing Activities.[10]

As the national authority on space matters, the Indonesian National Space Agency (LAPAN) plays a pivotal role in overseeing space activities. It is also responsible for providing guidance and setting procedures related to space-sensitive technologies within its jurisdiction.

2. Malaysia

Malaysia regulates space-sensitive technologies through various laws, regulations, and ordinances overseen by the Malaysian Space Agency (MYSA). The agency is critical in managing space activities and technologies within the country. As part of its international

[10] Christou Imanuel and Metha Ramadita, "Evaluasi Aspek Pertanggungjawaban Pada Tata Kelola Hukum Indonesia Dalam Menghadapi Pembangunan Fasilitas Peluncuran Roket Komersial," *Jurnal KPPA* 1, no. 1 (2021): 67–90, https://doi.org/10.30536/jkkpa.v2n1.4.

commitments, Malaysia has signed two key United Nations treaties—the Outer Space Treaty of 1967 and the Rescue Agreement of 1968—to safeguard national security and sovereignty. Although Malaysia signed the Outer Space Treaty, it has not yet ratified it.[11]

Malaysia has demonstrated its dedication to fulfilling its international obligations in space since becoming a member of the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS) in 1994. This commitment was further solidified with the Malaysian Space Board Act 2022 (Akta 834) enactment on January 25, 2022. This act empowers the Ministry of Science, Technology and Innovation (MOSTI) to take necessary steps towards ratifying all space-related international treaties and conventions.

In its ongoing efforts to address regulatory needs related to space, Malaysia has developed the National Space Policy 2030. This policy aims to strengthen governance to optimize access to space capabilities, focus on significant space technology, infrastructure, and applications, accelerate the development of space science and technology expertise, contribute to national economic prosperity, and enhance international cooperation and relations.[12]

3. Singapore

Singapore currently lacks specific legislation dedicated to regulating space-sensitive technologies. Instead, the government administers this sector using existing regulatory and policy frameworks, such as the National Science, Technology, and Research Act and the National Security Act. The Singapore Space and Technology Association (SSTA) and the Economic Development Board (EDB) partially manage the space sector's Oversight and promotion. The SSTA, a private industry association, operates independently of direct government control, guided generally by laws related to the freedom of association in Singapore.

4. Philippines

The Philippine Space Act, or Republic Act No. 11363, governs the space sector in the Philippines. Enacted on August 8, 2019, this legislation provides a comprehensive legal framework for developing and utilizing space technology within the country.[13] Key provisions of the law include (a) Establishment of the Philippine Space Agency: The Act establishes the Philippine Space Agency (PhilSA), which is tasked with coordinating and overseeing the nation's space-related programs and activities. (b) Space Research and Development: The law promotes research, development, and innovation in space science and technology, fostering international cooperation. (c) Utilization of Space Technology: The Act advocates for the application of space technology to enhance national development across various sectors, such as agriculture, health, communications, navigation, and disaster mitigation. (d) Training and Education: The law emphasizes the importance of training and educational programs in space science, aiming to increase public awareness and understanding of the benefits and potential of space technology. The law provides a strong legal foundation for developing the space sector in the Philippines and enables the country to engage actively in international space activities.[14]

5. Thailand

Thailand's space activities are regulated under the Space Activities Act B.E. 2562 (2019), along with associated regulations and announcements made by the National Research Council of Thailand in 2018. This act provides a legal framework that addresses the regulation of

[11] Ahmad Mohd Zain et al., "Malaysia in Space," *ASM Science* 12, no. 2 (2019), www.akademisains.gov.my.

[12] Ahmad Mohd Zain et al., "Malaysia in Space," *ASM Science* 12, no. 2 (2019), www.akademisains.gov.my.

[13] Q Verspieren et al., "An Early History of the Philippine Space Development Program," *Acta Astronautica*, 2018, https://doi.org/10.1016/j.actaastro.2018.06.043.This.

[14] Sese, Rogel Mari. "The Philippine Space Program: A Modern Take on Establishing a National Space Program." *ASEAN Space Programs: History and Way Forward* (2022): 57-77.

sensitive space technologies and includes provisions for licensing, environmental protection, liability, and national security. Although Thailand does not yet have a comprehensive national space law to regulate its space sector in alignment with international principles set forth by the United Nations (UN)[15], the country manages space affairs through various agencies. The most prominent is the Geo-Informatics and Space Technology Development Agency (GISTDA), which the Thai Cabinet mandates to oversee space-related activities. However, GISTDA does not formulate centralized and comprehensive space policies or regulations. Despite these challenges, Thailand maintains a space presence, owning satellites for telecommunications and natural resource exploration. Moreover, several entities have been established (or are planned to be established) to handle satellite-related matters, including GISTDA and the National Space Policy Committee (NSPC).[16] While specific space legislation is still forthcoming, these initiatives reflect Thailand's ongoing commitment to advancing its space programs and leveraging space technology for national development.

6. Vietnam

In Vietnam, space technology and law development has been hindered by historical challenges such as periods of war and economic difficulties, resulting in a lag behind many other countries. Vietnam lacks a standardized and specialized legal framework for space, relying instead on international treaties it has joined, national policies, and various independent laws such as the Information Technology Law, Atomic Energy Law, and Cyber Security Law. The country is actively working towards establishing a unified state management model for space, developing a National Space Law, and creating legal foundations for the acquisition and use of earth observation data, as well as laws for compensation related to damages caused by space objects, domestically and internationally. It is crucial for Vietnam to harmonize its space laws with international standards to maximize rights and benefits from space and regulate civil and commercial activities related to its exploitation and use, thereby supporting its emerging space sector and ensuring responsible participation in the global space community.

7. Laos

Laos established the Law on Research and Utilization of Outer Space (No. 62/NA), promulgated on 17 December 2010. This law provides the legal framework for Laos's space research, utilization, and development activities. Some of the key provisions in the Lao space law include (a) Scope and Definition: This law defines outer space and its scope of application in the territory of Laos. (b) Space Research and Utilization: This law regulates space research and utilization activities, including scientific research, technology development, and the use of space resources. (c) Licensing and Authorization: This Act establishes a licensing and authorization system for activities related to space research, satellite operations, and the use of space technology. (d) International Cooperation: The Act encourages international cooperation in space research and utilization, including collaboration with international organizations and other countries. (e) Responsibility and Security: The Act provides provisions on the responsibilities and security measures associated with space activities to ensure the safety of individuals, property, and the environment. (f) Protection of National Security: The law includes provisions to protect national security interests and prevent using space activities for unlawful purposes.[17]

8. Brunei Darussalam

[15] Pimtawan Nidhi-u-tai, "Thailand's Draft National Space Act: Legal Developments in the Registration System and Space Debris Mitigation Measures," no. January (2021): 1–23.
[16] Pimtawan Nidhi-u-tai, "Thailand's Draft National Space Act: Legal Developments in the Registration System and Space Debris Mitigation Measures," no. January (2021): 1–23.
[17] Le Thi Khanh Linh; Hoang Thao Anh; Tran Thi Dieu Ha; Nguyen Luu Lan Phuong; Le Thi Thuy Nhi, "Space Law in Vietnam : Outer Space Policy, Legal Development and Its Future Pathway," *AD ASTRA*, 2022, https://doi.org/10.53261/adastra20220502.

Although Brunei Darussalam does not have specific legislation dedicated to space activities, it is important to recognize the country's commitment to adhering to international treaties and agreements that govern space exploration and exploitation.

9. Myanmar

International space law treaties and conventions bind Myanmar. The Outer Space Treaty of 1967, in which Myanmar was a party, established basic guidelines for space research and exploitation. Unfortunately, no formal space law applies in Myanmar.

10. Cambodia

Cambodia has not passed any laws devoted only to space-related matters. However, Cambodia has ratified an international agreement about space law.

Country	**Law/Regulations**	**Scope of Space Sensitive Technology Arrangement**
Indonesia	Space Law	Comprehensive arrangements include licensing, security, nonproliferation, and space technology export controls.
Malaysia	Deed of Space, Regulation of Space	Regulations covering space activities, licensing, export controls, and national security.
Singapore	No specific legislation	Rely on existing regulatory and policy frameworks, including the National Science, Technology, and Research Act and the National Security Act.
Thailand	Space Activities Act B.E. 2562 2019, Regulation of the National Research Council of Thailand	Regulations covering licensing, national security, and international cooperation.
Vietnam	No Space Law	Outer space activities are based on bilateral or multilateral agreements that regulate license requirements, environmental protection, international cooperation, and national security.
Filipina	Philippine Space Act	Regulations cover establishing a national space agency, licensing, technology development, and international cooperation.
Laos	Law on Space Research and Utilization	Regulations covering research, utilization, licensing, and supervision of space activities.

Meanwhile, three ASEAN member states—Myanmar, Brunei, and Cambodia—currently lack space or space-sensitive technology regulations. Despite this, as part of ASEAN, these countries actively participate in regional cooperation and adhere to ASEAN agendas related to space, including sensitive technologies. Although ASEAN, as a regional organization, does not specifically mandate cooperation on space-sensitive technologies, member countries are free to

engage in bilateral or multilateral agreements with nations outside of ASEAN regarding these technologies.

Space technology capabilities within ASEAN are predominantly concentrated among its founding members. Indonesia, Thailand, Malaysia, Singapore, and the Philippines continue to lead in space technology within the region. Within the ASEAN framework, space activities are overseen by the Sub-Committee on Space Application (SCOSA), which focuses on utilizing space technology. However, coordination among ASEAN member states during SCOSA activities has yet to reach optimal levels. Space cooperation among member states remains sporadic and primarily confined to space technology development. There is yet to be a unified program for collectively developing satellite launchers and satellite technology.

To enhance the efficacy of ASEAN space cooperation, it is crucial to explore both the opportunities and challenges that must be addressed. This will facilitate the realization of ASEAN Space Cooperation as a platform that fosters the integration of space technology development and supports broader ASEAN community integration.[18]

C. Conclusion

Examining sensitive technology policies in ASEAN countries reveals varying levels of regulatory frameworks. Indonesia, for instance, is governed by a Space Act specifically dedicated to its space sector, while Malaysia's space activities are regulated through both a Space Act and accompanying Space Regulations. Despite lacking a dedicated space law, Singapore manages space technology issues through broader existing laws like the National Science, Technology, and Research Act and the National Security Act. In Thailand, the Space Activities Act B.E. 2562 2019 and associated regulations and directives from the National Research Council of 2018 oversee space endeavors. Without a specific Space Law, Vietnam relies on bilateral or multilateral agreements to address aspects such as licensing, environmental safeguards, international collaboration, and national security concerning space activities. The Philippines and Laos each have a comprehensive legislative framework for space activities, known as the Philippine Space Act and the Law on Space Research and Utilization. Conversely, Myanmar, Brunei, and Cambodia currently have no specific legal frameworks addressing space or space-sensitive technologies.

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