



Space Law and Space Mining, Exploring New Horizons Amid COVID-19 Pandemic

Marcin Jakub Drobnik ¹, Ivan Bimbilovski ², Shubham Pathak ^{3*} 

¹ Walailak University International College (WUIC), Walailak University, Nakhon Si Thammarat 80160, Thailand.

² University of Information Science and Technology "St Paul the Apostle", 6000 Ohrid, North Macedonia

³ College of Graduate Studies (CGS), Walailak University, Center of Excellence in Sustainable Disaster Management (CESDM), Thai Buri, Tha Sala and 80160, Thailand.

Abstract

This study analyses the current scenario with COVID-19 affecting the international and Thai space law, and its impacts and corresponding repercussions upon the Thai economy, ASEAN region and then at international level. The methodology adopted for this study is a mixed method with qualitative research tools collected from key informant interviews and focus group discussions. The data analysis involves the Strength, Weakness, Opportunity, and Threat (SWOT) analysis, which has been integrated with Hierarchical Thematic areas to provide the supporting model for wholesome recommendations through analyzing the findings from the research. The key respondents involved several government officials associated with Thai space agencies and departments, along with judges, lawyers, researchers, academicians, non-government organizations (NGO) officials, and law students. The findings provided the need for adoption of Treaty leading to the creation of a space organization which would be accountable towards setting up a legal framework for commencement of space mining operations. The international space tribunal is to be created under this international space organization to resolve any disputes arising out of space mining. The overall implications of this research would lead to the sharing of the benefits of space mining with both developed and developing countries to enhance sustainable development for all mankind.

Keywords:

Space Law;
Space Mining;
COVID-19;
Laws;
Legal Framework;
Sustainable Development.

Article History:

Received:	05	October	2022
Revised:	02	December	2022
Accepted:	23	December	2022
Published:	16	January	2023

1- Introduction

Space laws have been an integral part of laws and policies since the first aeronautical space shuttle was launched in 1957. The first flight of Sputnik and the subsequent 5,600 launches of artificial objects into space initiated the creation of a completely new branch of law, which is space law [1]. Effective international declarations, agreements, treaties, and conventions are an integral part of implementing space laws that are safe and beneficial to mankind [2]. The global goal of space exploration and the sharing of resources extracted by space miners depends on the effective implementation of space laws. Sustainable development and economic growth are enhanced along with proper space mining exploration [3]. Therefore, it becomes necessary to revisit the space laws and try to link the existing technological progress with the overarching goals of strengthening international cooperation and collaborative sustainable development for mankind. Regarding international space law, the Committee on the Peaceful Uses of Outer Space has developed and ratified a number of legal documents, including five key treaties and five principles (see Table 1) related to outer space [4].

* **CONTACT:** shubhampathak@gmail.com

DOI: <http://dx.doi.org/10.28991/ESJ-2023-SPER-09>

© 2023 by the authors. Licensee ESJ, Italy. This is an open access article under the terms and conditions of the Creative Commons Attribution (CC-BY) license (<https://creativecommons.org/licenses/by/4.0/>).

Table 1. Major treaties, declaration and principles towards space law- Source: (United Nations Office for Outer Space Affairs, 2021)

Treaties				Declarations and legal principles			
S. No.	Title	Enforced	General Assembly Resolution	S. No.	Title	Enforced	General Assembly Resolution
1	Outer Space Treaty	10 October 1967	2222 (XXI)	1	Declaration of Legal Principles	13 December 1963	1962 (XVIII)
2	Rescue Agreement	3 December 1968	2345 (XXII)	2	Broadcasting Principles	10 December 1982	37/92
3	Liability Convention	1 September 1972	2777 (XXVI)	3	Remote Sensing Principles	3 December 1986	41/65
4	Registration Convention	15 September 1976	3235 (XXIX)	4	Nuclear Power Sources	14 December 1992	47/68
5	Moon Agreement	11 July 1984	34/68	5	Benefits Declaration	13 December 1996	51/122

The binding force of space law and the repercussions of misuse of space is a complex scenario. The provisions of the Space Law flow from concepts born from the Law of the Sea [5, 6]. However, the legal aspects must be sufficiently precise and transparent to manage and appropriately use space resources for the benefit of all humanity. To achieve this, several treaties have been adopted since space exploration began in 1957 and progressed since 1960s. These major treaties govern the conduct of states and other entities in outer space (see Table 1) and are overseen by the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS) [7]. All of these treaties focused primarily on security issues that were critical to technologically leading nations that were, in practice, the only ones interested in the exploration and exploitation of outer space [8–10]. However, the legal aspect has been overlooking the benefit of all mankind through appropriate legal protection and enhancing the social, economic, financial, and cooperative exploration of the endless resources in outer space [11, 12].

In terms of regional growth, most regional organizations follow a leading country, with other regional countries supporting the common goals. Some of the regional unions include the European Union (EU), the South Asian Association for Regional Cooperation (SAARC), the Association of Southeast Asian Nations (ASEAN), and the African Union (AU), to name a few. This is further witnessed in terms of the ASEAN region, where Thailand is one of the leading countries that has developed itself over the past few decades and provides legal and social reforms for both the Thai population and the ASEAN region [13].

Despite the governmental organizations working towards strengthening the space laws, there has been a considerable interest from the private sector to explore outer space as well. The governmental organization includes National Aeronautics and Space Administration (NASA), International Lunar Research Station (ILRS) whereas private companies include Space X (Elon Musk's), Space Team (Morgan Stanley's), Caterpillar Inc., Moon Express Inc. and Blue origin Inc. This calls for a clear, effective, and adequate space law and regulations to ensure safe space mining for the resources to be utilized peacefully [14]. The principles utilized in the Laws of the Seas through the International Seabed Authority (ISA) could be an exemplary guideline to ensure the Common Heritage of Mankind (CHM) and peaceful space mining [15, 16]. These combined resources and technological advancements would contribute to the sustainable development of the whole mankind. However, effective space laws are to be implemented to ensure adequate utilization of space mining.

Although space mining is a problem of the distant rather than the near future, it is already necessary to create clear principles on which it will be based. Knowledge of the legal framework will help states and other interested stakeholders plan the development of technology appropriately in order to start exploiting resources located in outer space, Moon and other celestial bodies as soon as possible. In the past, the International Seabed Authority began giving nations and other entities plots of land on the ocean floor, although there was no technical capability to extract resources from the bottom yet. This has led to the acceleration of research into technologies that enable mining at the bottom of the ocean. Experimental mining has been going on for quite some time, and large-scale mining is expected to start soon. The same mechanisms should work in relation to space mining: once the legal framework is in place, many entities will try to develop to start reaping the benefits of space as soon as possible. The basis of this research is based upon the fact that the benefit of mankind is the epitome of drafting, implementing, and regulating space mining [17–19].

Thailand, being one of the leading countries in the ASEAN region, is responsible towards the adequate space laws in Thailand to ensure economic development, cyber security, and the minimization of space debris and any future disastrous accidents. The Thailand national space master plan (2017-2036) has been implemented in Thailand with aims towards achieving sustainable development and national security in Thailand [20]. The digital innovations, space technologies and adequate space infrastructure would ensure social and economic growth in future towards the Thai economy [21].

The agencies involved in the creation and regulation of Thai space laws and policies are depicted in Figure 1.

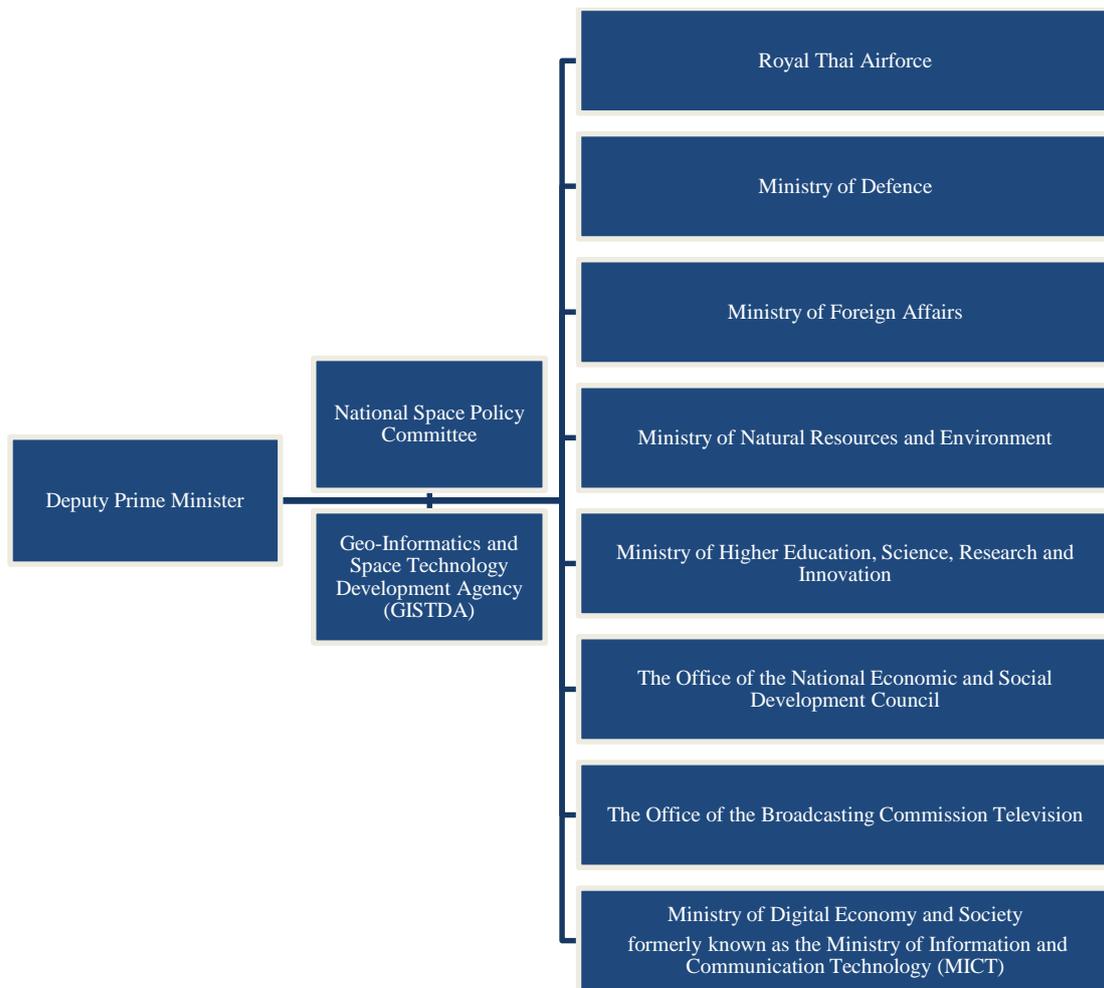


Figure 1. Organizational structure in the Thai Space law

There are several treaties signed by the department of treaties and legal affairs working under the Ministry of Foreign Affairs related to space law in Thailand. These treaties emphasize upon the optimal utilization available space resources with safety and welfare towards Thailand through adequate mining in the outer space inclusive of Moon and Celestial bodies. These treaties included the Outer Space Treaty of 1967, the Rescue Agreement of 1968, the Convention on International Liability for Damages Caused by Space Objects of 1972, the Convention on Registration of Objects Launched into Outer Space of 1975, and the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies of 1979.

Among the bilateral treaties, Thailand has signed several agreements and Memorandum of Understanding (MOUs) with regional and global space agencies and countries. These include the Agreement between the Government of the French Republic and the Government of the Kingdom of Thailand Relating on Cooperation in the Field of Space Technologies and Applications in 2000, the Agreement between the Government of the Kingdom of Thailand and the Government of the Republic of India on Cooperation in the Exploration and Use of Outer Space for Peaceful purposes in 2002, and the Memorandum of Understanding between the Ministry of Science and Technology of the Kingdom of Thailand and the Russian Federation and Space Agency on Cooperation in the Field of Space Technologies and Their Application in 2002.

Thailand has successfully drafted the Thailand Space Affairs Act, B.E. 2535 (2015), which is a continued effort from the Thailand Space Affairs Act, B.E. 2535 (2009), and is currently in the process of creating a full-fledged space law and agency infrastructure [22]. The initial draft act includes several ministries, departments, and agencies amalgamated into an effective infrastructure supporting the Thai space laws. These agencies are led by the National Space Policy Committee (NSPC) in collaboration with the Geo-Informatics and Space Technology Development Agency (GISTDA) under the chairmanship of the deputy prime minister (see Figure 1). The act becomes an essential tool to smooth the planning and implementation of accurate space laws in Thailand. However, the shift towards Covid-19 pandemic has adversely affected the growth and development of the planning of the space laws in Thailand. There are several ministries and space laws that need to be streamlined in terms of the effectiveness of the ACT and ensuring the cyber, social, and economic safety of Thailand. The extended impacts will be upon the neighbouring states; therefore, adequate laws are to be initiated to ensure minimum damage and maximum advantage for the Thai economy.

Similarly, in terms of the private sector in Thailand, Small and Medium Enterprises (SMEs) are an integral part of the Thai economy, contributing towards 56,122 million THB and accounting for 35,600 SMEs, 95% of the SMEs belong to the small and medium enterprises, and the remaining 5% are among the large-scale industries, among the industrial sector's contribution towards the space laws in Thailand [23].

These existing frameworks provide the basis for an emerging space mining industry and apt resource extraction, utilization, and common benefits towards the mankind. The concerns remain with the factors such as legal disputes, nonbinding treaties that would enhance the vulnerabilities in the space as well as on earth due to space debris damages.

The existing research gap in the field of space mining deals with complexities of several factors working collectively towards the ineffectiveness of the space laws. This is further extended at the national and regional levels, which have specific political, social, and economic characteristics. The monetary nature of explorative space mining poses threats to safety and future conflicts. These threats are enhanced by the multiple stakeholders involved in space mining [24]. With the resources decreasing day by day, pandemic bringing the mobility to a standstill during COVID-19 pandemic and aggressive nature of political regimes in most parts of the world enhances the vulnerabilities due to inadequate space laws. This research presents the following research objectives and questions to cover the existing literature gaps:

- Analyze the existing space laws and their effectiveness towards mankind.
- Do the existing space laws enhance social, economic, financial, cultural and sustainable growth at national, regional and international level?
- What is lacking in terms of legal protection and effectiveness of the space laws?
- Will the legalization of space mining eradicate inequalities among countries and support the Sustainable Development Goals (SDG)?

2- Methodology

The legal doctrine has been utilized in legal research in recent decades to ensure the combined effect of existing arguments, logical interpretations of literature, and analysis of the collected data (Figure 2) [25]. The legal research presents a research avenue where the data provides for qualitative analysis to provide for regulatory support towards the policy makers [26].

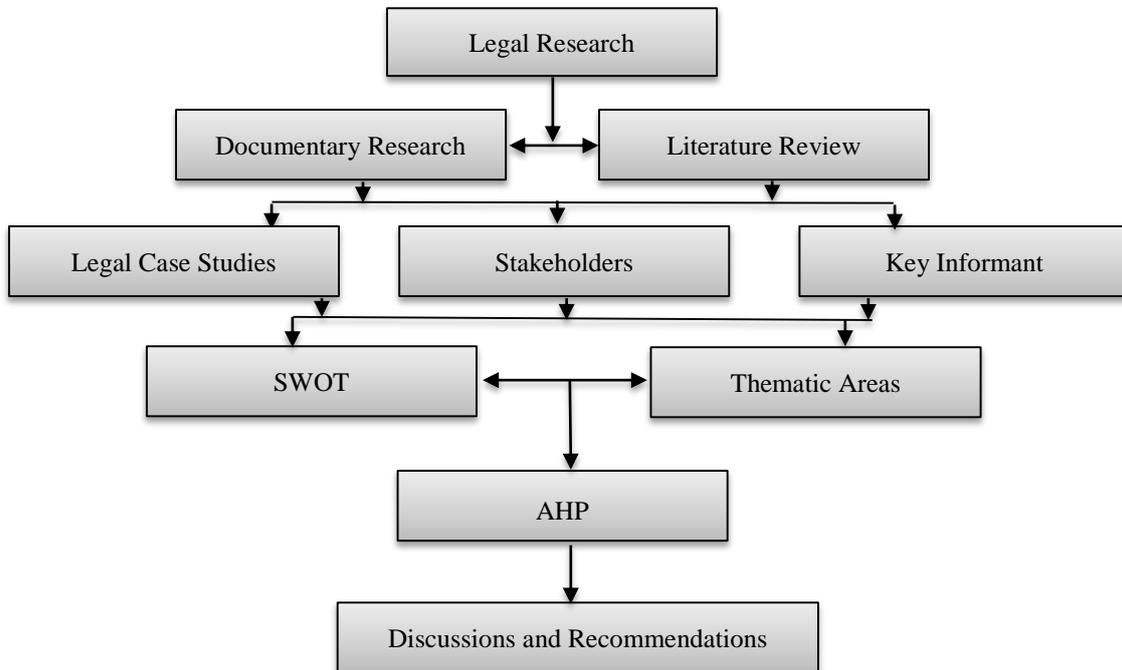


Figure 2. Flow chart of the methodology

The methodology adopted for this study is a qualitative one with research tools such as key informant interviews and focus group discussions. The methodology for this research has been documentary and literature review analysis. The literature provided for the real level data from both government and ground level implications of legal instruments in Thailand. The enhanced analysis involves the data collected from all the secondary sources. The study area is Thailand, with emphasis on the regions allocated for the space laws and programs being conducted. The key respondents involved

several government officials associated with Thai space agencies and departments, along with researchers working in leading universities, regarding the creation of space laws and their effective implementation in Thailand. The data analysis will involve classification and content analysis based on the themes and subthemes to analyze and interpret the findings from the research. The Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis provided for an in-depth understanding of the existing space laws and learning from this research that would be replicated or adopted in other parts of the globe.

The SWOT analysis has been integrated with Hierarchical Thematic areas to provide the supporting model to provide for wholesome recommendations [27–29]. The Hierarchical Thematic areas involve the model structure with comparative criteria, which is prioritized by the experts and stakeholders in the space law. These experts are randomly selected from various organizations, sectors, and countries to provide a wholesome understanding and prioritization of all the factors derived through the SWOT analysis (Table 2).

Table 2. Profile of the Key respondents

Serial Number	Sector	Male	Female	Education Level
1	Government officer	6	4	Graduate
2	Judge	2	2	LLM
3	Lawyer	5	4	LLB; LLM
4	Private Businessman	4	6	Graduate
5	Academicians	3	4	Graduate
6	NGO	2	3	Graduate
7	Law student	3	2	Undergraduate
Total		25	25	

3- Results and Discussions

The research finds out that there is negligible existing space law in terms of space mining and resource utilization thereof. The upcoming public and private initiatives in the field of space mining call for effective and adequate regulations to ensure sustainable development.

There are several similarities between the Law of the Sea and space law since the principles of sovereignty and central organization requirement to ensure adequate exploration of the resource for the benefit of mankind (Table 3).

Table 3. Comparison between law of the sea and space law

Law of the Sea	Space law
International sea and seabed mining	Outer space
<i>Res communis</i> - Territory outside the sovereignty of the State. Related with the concept of zonation in terms of boundaries of the sea-side States with coastal or Small Island States.	No sovereignty in the outer space
Successful treaty and effective implementation	Adoption of the concepts of the law of the sea to ensure effective implementation
Environmental norms to check the companies beyond the boundaries of their operations	Adoption of these norms to ensure the safety of the space mining stakeholders
Dispute resolution through Tribunal in Hamburg. However, for some specific norms related sea, the dispute resolution might by arbitration	Dispute resolution will be adopted along with the International tribunal for outer space (hypothetical name) to ensure the transparency of the tribunal and dispute resolution
Accountability- The private public partnership, the accountability lies with the State or the company, who is authorized to use the portion of the seabed.	Accountability- the similar concept will be implemented in terms of the law of the sea under the authorization of the organization created under the new space organization.

In both the Law of the Sea and the Space Law, the state has the right to give the sub-contract of the mining to private companies. For instance, a contract is signed with the private company for construction, however, this company gives sub-contract, the final unsatisfactory performance of the sub-contracting company will be still the obligation of the company that entered the contract.

The basic concepts of the law of the sea could be adopted for the space law as the implication of international security, sustainable development and benefit of the mankind is associated with both the laws [30]. However, in space law the sovereignty does not exist at all. This calls for a detailed analysis of each public or private mining contractor to be authorized under the organization of the outer space law. Any dispute would be resolved with final decision-making authority residing with the international tribunal for outer space.

One of the law professors among the respondents added, "The few regulations under the law of the sea are some of the best exemplary regulations or norms to be adopted in terms of outer space. It ensures safety, transparency, accountability, and legal protection for both public as well as private parties."

One of the government officers added, "The outer space belongs to the whole of mankind; therefore, we must ensure the adequate distribution of the profits or benefits earned through space mining. I feel that the accountability must belong to the state to ensure the regulations are implemented at the state level."

However, according to this research, it was found that accountability must be with the party who has been authorized by the space organization. One of the judges added, "The legal framework is the utmost factor to be considered during the consideration of drafting the details of the treaty and the creation of the tribunal for outer space. The robustness of the legal framework would ensure peaceful and secure sustainable development through the activities of outer space."

A law student studying international law added, "There must be economic viability in space mining. Otherwise, there is no need to mine the resources of space. The economic benefits must be shared with the whole of mankind."

The treaty must also involve the sharing of the benefits achieved through space mining among the developing countries as well. However, the percentage of the profits to be shared will be calculated and determined by the outer space organization designed under the treaty.

The parties to the dispute are depending on the authorization from the international tribunal for outer space. The transboundary damage concept of the environmental norms could also be adopted in the space law to ensure environmental security and sustainable development. The political will of the States to join this treaty and thereof the international space organization is a must to commence the space mining. This would be under the principle of no sovereignty in space. Therefore, the state must accept the treaty to commence or initiate the space mining activities. This further implies to the private companies who will be under the regulations of first the state and then the international space treaty before they commence space mining.

This would be different in the case of the multinational company, which was created under one of the states; then, the accountability resides with the registration in the state where this private company is registered [31–33]. However, these multinational companies could be an independent party under all the regulation/jurisdiction of the outer space organization. This opens another avenue for the sub-contractors to both the State owned or private company owned, and then who will be held accountable for any damages. This require to be sorted while the drafting of the outer space treaty. Under the outer space organization must provide the license to these sub-contracting companies. The hiring of these sub-contractors will only be allowed once they fulfill all the requirements under the licensing agreement with the outer space organization. This would ensure the safety and peaceful operation of space mining.

Sustainable development requires the development of all developed as well as developing countries. *Salus populi suprema lex esto* by Marcus Tullius Cicero is saying, which implies "The health (welfare, good, salvation, felicity) of the people should be the supreme law" - that could be used to justify the division celestial bodies into portions and assign them to States. This could be extended to other entities, so the part of benefits could be given to other developing states [34]. This space law would ensure the sharing of the benefits, inclusive of knowledge sharing, technological advancement, preferential rights to explore space mining, and monetary benefits.

One of the respondents from developing countries added, "What is in store for us? Do we really get the benefits, or do the rich get richer? The treaty should incorporate the actual benefits for our developing country else it is just another feather in the rich company's cap."

This treaty will open avenues not only for the developed countries but also for the developing ones. These developing countries would benefit from the experiences of the developed nations, explore further with international assistance, and achieve self-sustainability in the future. However, this would take some time to be implemented and learn the lessons from experiences of developed countries who would initiate the space mining in the commencement of the space mining activities.

One of the respondents among leading NGOs in Thailand added, "Who controls the space mining? How do we know the accountability of each involved party? We are not lawyers; we are just here to assist the general people."

Another NGO's respondent added, "How can this new treaty ensure that governments (State) will follow the regulations without corruption? Who will decide the safety regulations? Are you sure the space will not turn into a mad business world like we have today in global markets?"

The answer to these insecurities lies in the principle of *Pacta Sunt Servanda*, which strictly implies that when a state signs the treaty, they are obliged to follow all the deemed regulations under the treaty. All the disputes arising due to corruption, human negligence, or man-made accidents would be directly processed under the international tribunal for outer space. However, this would be incorporated wholesomeness in the treaty as well as while setting up the tribunal regulations. Thus, the rulings of the space tribunals would be ultimate judgments in cases of any disputes arising out of space.

The political will of the state is also to be kept in mind while forming the articles of the treaty. For instance, *L'état c'est moi*, a famous quote by the French King Louis the XIV, which implies that the "I myself am the nation." Therefore, it is necessary for the treaty to ensure that each state's government must enter the treaty as a state and not as an individual. This includes the States with both a monarchy and a democratic system.

One of the respondents from the space agency of a developing country added, "My country or state does not have the resources to do space mining? Are you sure we will benefit from signing this treaty? If not, then why should we sign it?"

This treaty will open avenues not only for the developed countries but also for the developing ones. These developing countries would benefit from the experiences of the developed nations, explore further with international assistance, and achieve self-sustainability in the future. However, this would take some time to be implemented and learn the lessons from experiences of developed countries who would initiate the space mining in the commencement of the space mining activities.

Likewise, if the state does not sign the treaty, the reservation of the resource-rich portions of the moon and celestial bodies would go to the states that signed the treaty before. The possession of the territories assigned by the international space organization will be held by the state or a private company, which will then have their own space mining agencies or enter contracts with subcontractors from the private sector. It must be noted that the ownership of this territory still resides with the international space organization. Thus, the rulings of the space tribunals would be ultimate judgments in cases of any disputes arising out of space mining.

Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis (Figure 2).

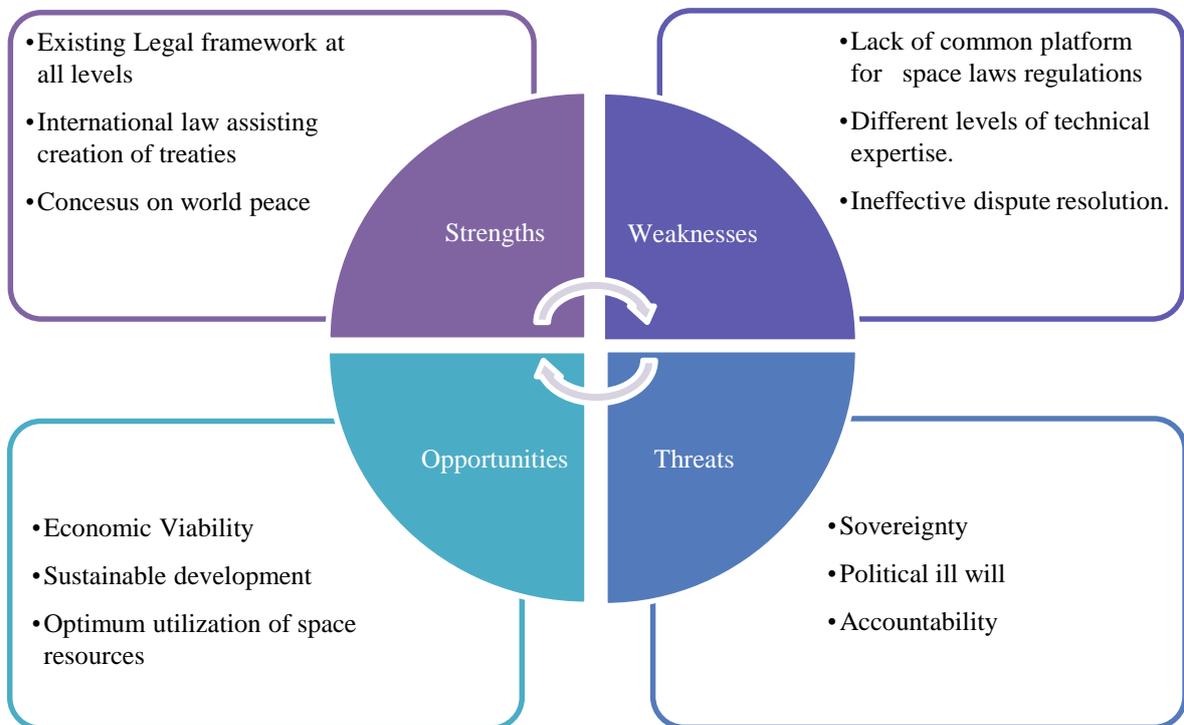


Figure 3. SWOT analysis for the space laws

Strengths: One of the biggest strengths is the existing legal framework at all levels, may it be international, national, or local. The effectiveness of these legal frameworks throughout the globe is questionable, but the fact that they do exist implies the accomplishment of the first step towards the effectiveness of the space law. These frameworks have provided robust international law, assisting in the creation of treaties and organizations that ensure equal and adequate resource mining and management on earth as well as in space. The consensus on world peace throughout the globe could be witnessed through the peaceful satellite system and large networks of communication satellites peacefully operating in space. Thus, the factor attained through the strengths is the importance of the legal framework, which is coded as S1.

S1- Legal framework

Weaknesses: Despite the active interests among the public and private sectors in space mining and space exploration, there are several weaknesses that hamper growth and sustainable development. These include the lack of a common platform for space law regulations, which is a major gap in ensuring adequate sharing of resources as well as the benefits of space mining to all the States. Several states are found to be lacking in terms of technological advancement and must rely upon the more advanced, knowledgeable, and technically sound states. The different levels of technical expertise

results in the in-adequate exploration levels of the States. However, the major weakness resides in the absence of effective dispute resolution when it comes to the rights of states at the international level. Thus, the major weakness found is ineffective dispute resolution, which is coded as W1.

W1- Dispute resolution

Opportunities: Several opportunities would be presented through adequate space laws. These include legal protection for all mankind, economic viability to assist developing states and achieve resilient and sustainable development, which would be achieved through the implementation of adequate and optimum utilization of space resources. Thus, there are two major opportunities found through this research, which are coded as O1 and O2.

O1- Economic Viability

O2- Sustainable development

Threats: The major threat towards the effective space mining resides in the accountability issues pertaining to the responsibilities of the State, space organization and effectiveness of the legal framework to resolve dispute resolution effectively and peacefully. The inclination of more resourceful States or private companies which might turn out to monopolize the space mining. The absence of the principle of sovereignty in space reduces the accountability of the states, which have their own or sub-contractors for space mining activities. This would be escalated with the possible political ill will towards benefit sharing arising from the space mining. Therefore, the biggest threat found through this research is accountability and has been coded as T1.

T1- Accountability

The findings of the SWOT analysis were then shared with the experts in the field of law and implementation of legal framework at all levels of governance. Based on the final ranking of the experts, it was found that the major factors affecting the effectiveness of space mining were the legal framework, accountability, economic viability, sustainable development, and dispute resolution (Table 4).

Table 4. Hierarchical final ranking after the expert ranking

Serial Number	Factors	Final ranking
S1	Legal framework	1
W1	Dispute resolution	5
O1	Economic Viability	3
O2	Sustainable development	4
T1	Accountability	2

The discussion presents the amalgamated effect of existing as well as the findings of this research. This research provides for the bridging of the gaps and ensuring sustainable development through effective space mining and an adequate legal framework to maintain justice for all mankind [35]. The Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of all States has considered the needs of developing countries.

Paragraph 2:

"States are free to determine all aspects of their participation in international cooperation in the exploration and use of outer space on an equitable and mutually acceptable basis. Contractual terms in such cooperative ventures should be fair and reasonable, and they should be in full compliance with the legitimate rights and interests of the parties concerned, as, for example, with intellectual property rights."

It also states that states are free to determine all aspects of their participation in international cooperation in the exploration and use of outer space on an equitable and mutually acceptable basis. However, contractual terms in such cooperative ventures should be fair and reasonable, and they should be in full compliance with the legitimate rights and interests of the parties concerned, as, for example, with intellectual property rights.

The existing legal documents are found to be supporting the following:

- Recognizing the common interest of all mankind in the progress of the exploration and use of outer space for peaceful purposes,
- Believing that the exploration and use of outer space should be carried on for the benefit of all peoples irrespective of the degree of their economic or scientific development,
- Desiring to contribute to broad international cooperation in the scientific as well as the legal aspects of the exploration and use of outer space for peaceful purposes,

- Believing that such cooperation will contribute to the development of mutual understanding and to the strengthening of friendly relations between States and peoples,

Similarly, the articles under the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies which provide direct guidelines towards sustainable development are as follows:

Article I

“The exploration and use of outer space, including the Moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, (...) and shall be the province of all mankind.

Outer space, including the Moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies. (...)”

Thus, article 1 clearly states the benefit of the extracted resources or economic benefits through space mining to be shared equitably *Res communis* (or *Res communis omnium*) “a thing that is for all” (common property not allowing private ownership); both implying the common heritage of mankind [35]. This would involve years of experience to learn innovative technologies and implement the space mining projects, especially the developing countries. This space organization must include the knowledge and benefit sharing concept from the initiation of the space mining legal framework and processes.

Article II

“Outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.”

As mentioned earlier, there is no sovereignty in the outer space, this however, would be difficult to understand once the space organization transfers the rights to use the determined territories by a specific State or company. This would be followed under the concept of *Res extra commercium* “a thing outside commerce.” Despite of this, the ownership resides with all mankind represented by the newly created space organization.

Article VI

"States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the Moon and other celestial bodies, whether such activities are executed by governmental agencies or by non-governmental entities, and for ensuring that national activities are carried out in conformity with the provisions set forth in the present Treaty. The activities of non-governmental entities in outer space, including the Moon and other celestial bodies, shall require authorization and continuing supervision by the appropriate State Party to the Treaty. When activities are executed in outer space, including the Moon and other celestial bodies, by an international organization, responsibility for compliance with this Treaty shall be borne both by the international organization and by the States Parties to the Treaty participating in such organizations."

Accountability, responsibility, or liability would reside with the States or private companies, or sub-contractors who will be physically conducting the space mining activities in outer space [36]. However, the liabilities of sub-contractors will be limited to the contract or agreement with the major contractual party who received the rights to use or mine the territory on Moon or celestial bodies in outer space. These sub-contractors would require a direct license to operate space mining in outer space. Therefore, the clear accountability would lay with the parties (both states and private companies) entering into a contract or agreement with the space organization.

Article VIII

"A State Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object and over any personnel thereof while in outer space or on a celestial body. Ownership of objects launched into outer space, including objects landed or constructed on a celestial body, and of their component parts, is not affected by their presence in outer space or on a celestial body or by their return to the Earth (...)."

Ownership of the space equipment would reside with the state where it is registered to be constructed and used. The similar jurisdiction will apply to all the other equipment and any accidents arising out of this equipment. For instance, if one state has their territory on the Moon, it will be treated as the state's soil in the context of jurisdiction, but the ownership of the said territory will still reside with the space organization.

Article XII

"All stations, installations, equipment, and space vehicles on the Moon and other celestial bodies shall be open to representatives of other States Parties to the Treaty on a basis of reciprocity. Such representatives shall give reasonable advance notice of a projected visit, in order that appropriate consultations may be held and that maximum precautions may be taken to assure safety and to avoid interference with normal operations in the facility to be visited."

The combined space mining operations would enhance the collaboration, knowledge sharing, and economic viability of all the concerned parties, providing sustainable development and benefits to all mankind. This would empower all the concerned stakeholders, inclusive of states, contractors, and sub-contractors to explore new avenues and technological advancements in space mining. The involved parties would be performing under the direct supervision of the signed contracts between the state and the space organization. This would be extended under the direct supervision of the concerned state to regulate the space organization's licensed sub-contractors through adequate security and peaceful conduct in outer space.

Article XIII (...)

“Any practical questions arising in connection with activities carried on by international intergovernmental organizations in the exploration and use of outer space, including the Moon and other celestial bodies, shall be resolved by the States Parties to the Treaty either with the appropriate international organization or with one or more States members of that international organization, which are Parties to this Treaty.”

The new treaty would follow the principle of *Lex posterior derogat legi priori* and *lex specialis derogat legi generali*, which would derogate Article XIII. All the cases arising from these space mining activities would fall within the scope of the jurisdiction of the space organization and be finally resolved by the international space tribunal.

These articles clearly implies that the States are under the obligations of following the principle of *Ius est ars boni et aequi* which was first used by the Romans to describe that the law should be equitable and fair [36, 37]. Eventually, this principle implies that sustainable development will benefit all mankind through the just and fair implementation of space mining regulations (Figure 4).

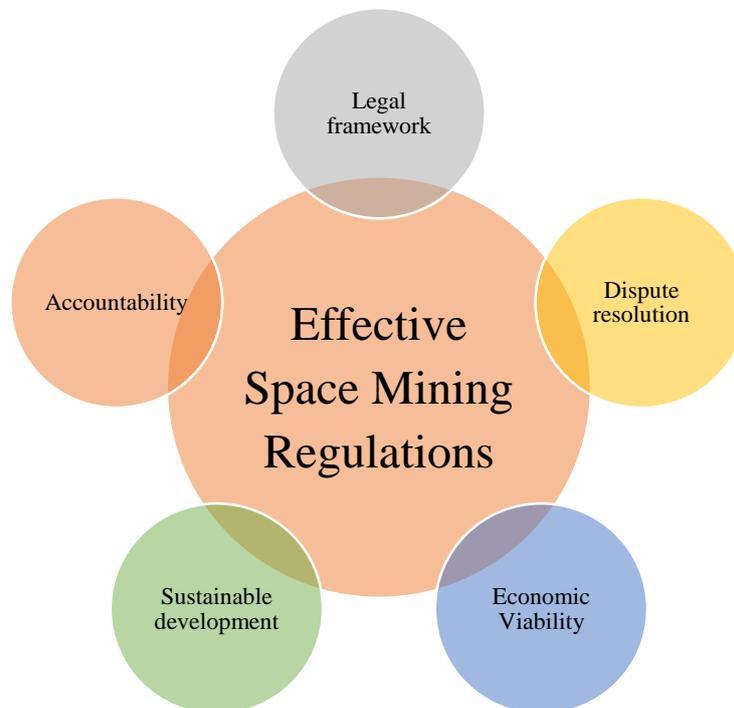


Figure 4. Thematic areas ensuring effective space mining regulations

Thailand is a growing economy in the ASEAN region. Recent trends have shown a growth in poverty eradication regimes in the past few decades [38–40]. However, it is essential to effectively involve in the creation of a legal framework to ensure the apt leadership of Thailand as one of the growing economies in the ASEAN region. These would ensure sustainable development at both the national as well as regional level through adequate implementation of the space law in Thailand.

These discussions provide for the overall implication of space mining at the international as well as national level. Thailand is a growing economy in terms of space law. The sustainable development of Thailand would not only assist the Thai economy but would in turn assist the other developing states in the region of the Association of Southeast Asian Nations (ASEAN).

Hierarchical Thematic Areas:

The selected factors obtained from the SWOT analysis were categorized into the Hierarchical Thematic areas with the assistance and expert opinions of the respondents. These thematic areas are supported by the findings of this research.

Each theme provides for a detailed discussion to provide for effectiveness of the space mining regulations and to ensure the prevalence of justice.

- **Legal framework:** The legal framework is found to be the most important and major factor in initiating the legal protection of all the stakeholders involved in space mining.
- **Accountability:** It is deemed essential that each stakeholder involved in space mining is accountable to ensure full responsibility by each party involved in space mining.
- **Economic Viability:** The enormous costs involved with space mining call for the viability of the whole process. This involves the economic viability of both developed as well as underdeveloped states.
- **Sustainable development:** The major output of space mining would be the attainment of sustainable development. This would then be divided into the SDGs at all levels of governance and regulation.
- **Dispute resolution:** There is a dire need for peaceful and just dispute resolution in a space mining scenario. The regulations governing space mining must ensure justice for all parties involved. The damages may arise due to accidents, natural calamities, or any other mishap during space mining.

4- Conclusion and Recommendations

The present research provides an in-depth analysis of the future of space mining in terms of sustainable development for mankind. The following recommendations are provided with a focus on all three levels of governance and understanding the implications of the COVID-19 pandemic slowing down legal procedures all around the globe.

- ***For International Level:***

- A. Initiation of a United Nations treaty: Establishment of a new organization to collect and ensure effective space laws and regulations.
- B. Initiation of creation of a Treaty for space tribunal under organization (A) to ensure protection of the mankind.
- C. Jurisdiction and legal competencies must be under the space tribunal. The effects of (A), (B), and other existing space laws would be applicable to all parties.
- D. Accessibility, exploration, and accountability must be directly under (A) and other existing laws.
- E. The parties who are allowed to explore space must be inclusive of governments, public and private parties, however, must abide by (A) and (B).

- ***For Regional Level:***

- A. Sustainable development of all regional associations around the globe.
- B. Binding accession and ratification of the new treaties by the European Union.
- C. Binding accession and ratification of the new treaties by ASEAN and SAARC countries.
- D. Binding accession and ratification of the new treaties by African countries, including the African Union (AU), the Intergovernmental Authority on Development (IGAD), the East African Community (EAC), the Southern African Development Community (SADC), the Economic Community of Central African States (ECCAS), etc.
- E. Binding accession and ratification of the new treaties by other associations of countries, including the Shanghai Cooperation Organization (SCO), the Community of Latin American & Caribbean States (CELAC), the Economic Community of West African States (ECOWAS) Commission, and the Economic Cooperation Organization (ECO).

- ***For National Level:***

- A. Assumption that there is no sovereignty in the space. It must be implemented that there is no sovereignty in the space.
- B. Facilitation of cooperation between public and private parties for exploring and securing space mining.
- C. Enhancing the space agency's rights under the national law for economic, financial, social, and cultural benefits.
- D. Adoption and harmonization of national laws under the space organization 1(A).
- E. Damage and dispute resolution under the moon and other celestial bodies' mining. However, space accidents are to be resolved under the existing space laws and treaties.

This study paves the way for future research into the detailed articles and clauses of the space law treaty to ensure the effectiveness of future space mining. The treaties, which would be under the newly created space organization, would be the general guardian of all the treaties related to space, both bilateral and/or multilateral. The future of research must develop a legal framework to ensure resilient and sustainable development for all mankind.

5- Declarations

5-1-Author Contributions

Conceptualization, M.D. and S.P.; methodology, M.D. and S.P.; software, M.D. and S.P.; validation, M.D., I.B., and S.P.; formal analysis, M.D. and S.P.; investigation, M.D. and S.P.; resources, M.D. and S.P.; data curation, M.D. and S.P.; writing—original draft preparation, M.D. and S.P.; writing—review and editing, M.D. and S.P.; visualization, M.D. and S.P.; supervision, M.D. and S.P.; project administration, M.D. and S.P.; funding acquisition, M.D. and S.P. All authors have read and agreed to the published version of the manuscript.

5-2-Data Availability Statement

Data sharing is not applicable to this article.

5-3-Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

5-4-Acknowledgements

The authors would like thank family and friends for constant support.

5-5-Institutional Review Board Statement

Not applicable.

5-6-Informed Consent Statement

Not applicable.

5-7-Conflicts of Interest

The authors declare that there is no conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely observed by the authors.

6- References

- [1] Popova, R., & Schaus, V. (2018). The Legal Framework for Space Debris Remediation as a Tool for Sustainability in Outer Space. *Aerospace*, 5(2), 55. doi:10.3390/aerospace5020055.
- [2] Clery, D. (2017). Treaty tested by space miners. *Science*, 358(6359), 19. doi:10.1126/science.358.6359.19.
- [3] Paxson III, E. (1993). Sharing the benefits of outer space exploration: space law and economic development. *Michigan Journal of International Law*, 14(3), 487–517.
- [4] United Nations Office for Outer Space Affairs. (2017). *Space Law Treaties and Principles*. United Nations, New York, United States. Available online: <https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties.html> (accessed on December 2022).
- [5] Petersen, S., Krätschell, A., Augustin, N., Jamieson, J., Hein, J. R., & Hannington, M. D. (2016). News from the seabed – Geological characteristics and resource potential of deep-sea mineral resources. *Marine Policy*, 70, 175–187. doi:10.1016/j.marpol.2016.03.012.
- [6] Stanford, M. J.. (2010). United Nations/Thailand Workshop on Space Law “Activities Of States In Outer Space In Light Of New Developments: Meeting International Responsibilities And Establishing National Legal And Policy Frameworks”. United Nations Office for Outer Space Affairs, 16-19, November, 2010, Bangkok, Thailand. Available online: <https://www.unoosa.org/pdf/pres/2010/SLW2010/01-05.pdf?fbclid=IwAR040oQnIsPiX1sDScmxUHMDLXNWHdlqRhRbIJQqwfgniC9JclEnf9lk5ns> (accessed on August 2022).
- [7] United Nations. (2022). Report of the Committee on the Peaceful Uses of Outer Space. United Nations, New York, United States. Available online: <https://documents-dds-ny.un.org/doc/UNDOC/GEN/221/025/6E/PDF/2210256E.pdf?OpenElement> (accessed on August 2022).
- [8] Denis, G., Alary, D., Pasco, X., Pisot, N., Texier, D., & Toulza, S. (2020). From new space to big space: How commercial space dream is becoming a reality. *Acta Astronautica*, 166, 431–443. doi:10.1016/j.actaastro.2019.08.031.
- [9] Tronchetti, F., & Liu, H. (2021). The White House Executive Order on the Recovery and Use of Space Resources: Pushing the Boundaries of International Space Law? *Space Policy*, 57, 101448. doi:10.1016/j.spacepol.2021.101448.
- [10] Deplano, R. (2021). The Artemis Accords: Evolution or Revolution in International Space Law? *International and Comparative Law Quarterly*, 70(3), 799–819. doi:10.1017/S0020589321000142.

- [11] Benkö, M., & Schrogl, K. U. (1997). History and impact of the 1996 UN Declaration on "Space Benefits." *Space Policy*, 13(2), 139–143. doi:10.1016/S0265-9646(97)00004-0.
- [12] Schmidt, N., & Svec, M. (2022). Breaking the Deadlock in the Space Mining Legal Debate. *New Space*, 10(2), 115–126. doi:10.1089/space.2021.0049.
- [13] Verspieren, Q. (2022). Comparison of Established ASEAN Space Programs and Lessons Learned. *ASEAN Space Programs*. Springer, Singapore. doi:10.1007/978-981-16-7326-9_7.
- [14] McKeown, B., Dempster, A. G., & Saydam, S. (2022). Artemis Accords: Are Safety Zones Practical for Long Term Commercial Lunar Resource Utilisation? *Space Policy*, 62, 101504. doi:10.1016/j.spacepol.2022.101504.
- [15] Xu, F., Su, J., & Mehdi, M. (2020). A Re-Examination of Fundamental Principles of International Space Law at the Dawn of Space Mining. *Journal of Space Law* 1. *MLA*, 44(1).
- [16] Elvis, M. (2020). Space Economy Grand Challenges. *Frontiers in Space Technologies, Specialty Grand Challenge*, *Frontiers*, 4, 1. doi:10.3389/frspt.2020.00004.
- [17] Mallick, S., & Rajagopalan, R. P. (2019). If Space is 'the Province of Mankind', Who Owns its Resources. An Examination of the Potential of Space Mining and its Legal Implications. Observer Research Foundation (ORF), New Delhi, United States.
- [18] Steffen, O. (2022). Explore to Exploit: A Data-Centred Approach to Space Mining Regulation. *Space Policy*, 59, 101459. doi:10.1016/j.spacepol.2021.101459.
- [19] Bhattacharya, K. G. (2018). The viability of space mining in the current legal regime. *Astropolitics*, 16(3), 216–229. doi:10.1080/14777622.2018.1536858.
- [20] Meechukhun, N. (2021). Thai Cabinet approves Space Affairs Act, promoting "New Space Economy" and space exploration in Thailand. *The Pattaya News*. Available online: <https://thepattayanews.com/2021/07/14/thai-cabinet-approves-space-affairs-act-promoting-new-space-economy-and-space-exploration-in-thailand/> (accessed on August 2022).
- [21] Ministry of Foreign Affairs Thailand (2021). Ministry of Foreign Affairs, Kingdom of Thailand, Bangkok, Thailand. Available online: <https://www.mfa.go.th/en> (accessed on December 2022).
- [22] Sivaraks, J., Malisuwan, S., & Kaewphanuekrungsi, W. (2021). Space Industry Development: Opportunities and Challenging in Thailand. *International Journal of Science and Management Studies (IJSMS)*, 4(5), 64–71. doi:10.51386/25815946/ijms-v4i5p106.
- [23] Sharon, A. (2020). Thailand working on National Space Act. *OPEN GOV*. Available online: <https://opengovasia.com/thailand-working-on-national-space-act/> (accessed on August 2022).
- [24] Van Hoecke, M. (2011). Legal doctrine: Which method (s) for what kind of discipline?. In *Methodologies of legal research: which kind of method for what kind of discipline?*, 1-18, Hart Publishing, Oxford, United Kingdom.
- [25] Leeuw, F. L., & Schmeets, H. (2016). *Empirical legal research: A guidance book for lawyers, legislators and regulators*. Edward Elgar Publishing, Cheltenham, United Kingdom.
- [26] Jakhu, R. S., Pelton, J. N., & Nyampong, Y. O. M. (2017). *Space mining and its regulation*. Springer International Publishing, Cham, Switzerland. doi:10.1007/978-3-319-39246-2.
- [27] Görener, A., Toker, K., & Uluçay, K. (2012). Application of Combined SWOT and AHP: A Case Study for a Manufacturing Firm. *Procedia - Social and Behavioral Sciences*, 58, 1525–1534. doi:10.1016/j.sbspro.2012.09.1139.
- [28] Abdel-Basset, M., Mohamed, M., & Smarandache, F. (2018). An extension of neutrosophic AHP-SWOT analysis for strategic planning and decision-making. *Symmetry*, 10(4), 116. doi:10.3390/sym10040116.
- [29] Saaty, T. L. (1990). How to make a decision: The analytic hierarchy process. *European Journal of Operational Research*, 48(1), 9–26. doi:10.1016/0377-2217(90)90057-I.
- [30] van Niekerk, G. J. (2013). Amende honorable and ubuntu: an intersection of ars boni et aequi in African and Roman-Dutch jurisprudence?. *Fundamina: A Journal of Legal History*, 19(2), 397-412.
- [31] Jakhu, R.S., Pelton, J.N., Nyampong, Y.O.M. (2017). Private Sector Space Mining Initiatives and Policies in the United States. *Space Mining and Its Regulation*. Springer Praxis Books, Springer, Cham, Switzerland. doi:10.1007/978-3-319-39246-2_6.
- [32] Saunders, M. K. (2019). Mining on Celestial Bodies: The Equitable Distribution of Benefits Doctrine and Distributive Justice. *The Australian Year Book of International Law*, 36(1), 195–238. doi:10.1163/26660229_03601010.
- [33] Weinzierl, M. (2018). Space, the final economic frontier. *Journal of Economic Perspectives*, 32(2), 173–192. doi:10.1257/jep.32.2.173.
- [34] Koch, J. S. (2018). Institutional framework for the province of all mankind: Lessons from the international seabed authority for the governance of commercial space mining. *Astropolitics*, 16(1), 1–27. doi:10.1080/14777622.2017.1381824.

- [35] Steele, S. M. (2022). International Space Law: A Hindrance to Space Activities or a Resolute Action for Change. *American Journal of Aerospace Engineering*, 9(1), 1–13.
- [36] Freeland, S., & Ireland-Piper, D. (2022). Space Law, Human Rights and Corporate Accountability. *UCLA Journal of International Law and Foreign Affairs*, 26(1), 1–36.
- [37] Svec, M. (2022). Outer Space, an Area Recognised as Res Communis Omnium: Limits of National Space Mining Law. *Space Policy*, 60, 101473. doi:10.1016/j.spacepol.2021.101473.
- [38] Samuel, G. (2022). Roman legal methods and reasoning (2). *Rethinking Historical Jurisprudence*, 79-103, Edward Elgar Publishing, Cheltenham, United Kingdom. doi:10.4337/9781802200744.00010.
- [39] Kongrukreatiyos, K. (2020). Thailand's Poverty on the Rise Amid Slowing Economic Growth. The World Bank. Available online: <https://www.worldbank.org/en/news/press-release/2020/03/03/thailands-poverty-on-the-rise-amid-slowing-economic-growth> (accessed on December 2022).
- [40] Khamken, P. W., Klomkul, L., Khaw-ngern, C. H., & Khaw-ngern, K. (2021). Sufficiency Economy Philosophy Towards Poverty Eradication in Thailand. *Psychology and Education Journal*, 58(1), 1406–1411. doi:10.17762/pae.v58i1.921.