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A LEGAL EVALUATION OF THE IMPACT OF ARTIFICIAL INTELLIGENCE ON OUTER SPACE ASSET-FINANCING

Abstract

The space industry has grown significantly in importance, with more and more private companies aiming to provide services within the space environment. These include space tourism and the extensive deployment of satellites for earth monitoring, communication, and space exploration. Technological developments have accelerated the ability of private companies to provide services and establish businesses in the space area, with several new businesses providing services worldwide. With the technological advances in AI, the space area has been an essential area for AI to be deployed and the challenges it may face. The challenges with AI in the space sector and regulations in the space sector overall is the global regulatory nature of the environment. This is incredibly challenging given the significant discussion regarding national AI regulations to deal with this fast-developing area. Based on the challenging regulatory environment and associated risks, financing these new business models has presented new complexities that must be taken care of. Asset-based financing of such operations represents vital opportunities to deal with the intricate complexities of such operations and the various legal environments. While liability and other challenges have to be considered both in light of national and international regulations that may have to be taken into account, asset

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financing represents a very attractive option given the priority and security of the interest in the space asset. Specifically, there are various remedies given that it reduces the risk of various non-compatible regulations in order to secure their concerning asset rights. Furthermore, pre-existing third-party interests can be looked up via online registries, reducing potential risks.

Key words: space law, financing, artificial intelligence, legal liabilities, space exploration.

JEL Classification: K33, K24, G15.

1. Introduction

The space industry has experienced a massive transformation in the last several decades, going from one primarily driven by governments to private sector gaining massive traction with private spaceflights. Private initiatives have been a major support for the creation of new technology, and stimulate innovation. The last decades have seen the launch of several private space companies such as SpaceX and Blue Origin, as well as Virgin Galactic. This shall enable to achieve significant cost savings while starting the new age of space activity.

Following the deployment of the transatlantic communications satellite Telstar 1, the first commercial space operations were initiated. The Communications Satellite Act of 1962, passed by the US government, granted private businesses the freedom to own and manage commercial satellites. The Commercial Space Launch Act of 1984, which expanded the US Commercial Space Transport Administration's remit, and the US Commercial Space Launch Competitiveness Act of 2015, which promoted commercial space exploration and exploitation, are the next significant phases of development [McCurdy 2019].

The number of private initiatives has greatly increased in the United States and across the world as a result of this steady deregulation. Commercial activity has more than quadrupled in size over the past 15 years, rising from 110 billion dollars in 2005 to approximately 357 billion dollars in 2020. The Space Foundation study estimates that the value of the global space economy reached $424 billion in 2020, up 70% from 2010. Morgan Stanley predicts that by 2040, the space industry's yearly revenue may surpass $1 trillion [Morozova, Korzovatykh 2021].

NASA invested $28 billion in the Apollo program in the 1960s, which is comparable to $288 billion today after accounting for inflation. The capacity of space startups to compete with major aerospace contractors like Boeing and Lockheed Martin has been demonstrated over the previous 20 years. The cost of a SpaceX rocket launch today can be 97% less than the price of a Russian Soyuz spacecraft trip in the 1960s.

A new age in space exploration started around the turn of the millennium when the first travelers launched into orbit. Twenty million dollars were spent on the initial journey to the ISS. The year 2021 marked a turning point in the growth of space tourism. Several firms started offering tourist flights into space after years of testing. Even if competition has driven down the cost of cargo missions, the cost of sending people into space has not currently significantly decreased [Gorbuntsova, Dobson, Palmer 2019].

There is the prediction that by 2030, the industry for space travel will be worth $3 billion. Use of suborbital devices for lengthy trips, such as those from London to Shanghai, is one of the potential directions in this field. In the next ten years, SpaceX wants to replace airplanes with shuttles and cut travel time from 15 hours on a plane to 40 minutes. However, for the business to succeed, companies will need to reduce the cost of such a flight to that of a business class ticket or even less to attract clients.

Undoubtedly, one of the industry's main drivers is space tourism, but for the time being, the communication sector is far more profitable. By 2022, SpaceX had carried out 64 Falcon 9 launch operations, placing 3,397 Starlink satellites into orbit. The estimate is that the global satellite communications (SATCOM) market had a value of $38.98 billion in 2017, and given the current trend and assuming an average annual growth rate of 11.45%, it will reach 83.25 billion dollars by 2028. The market for satellite communications will likely expand significantly as more and more businesses seek to enter it. As sales of mobile devices and Internet apps rise together with the need for mobile broadband connection, this will occur. Several private businesses, primarily Starlink, Oneweb, SES, Intelsat, Telesat, and Viasat, are the major players in the telecommunication market [Winkler, Rusli, Pasztor 2015].

At least 5,465 operational satellites are orbiting the Earth, with the majority being launched by American entities. The global industry for satellite communications has seen the most success in Western nations. While Russia, Europe, and Canada are converting their international businesses into domestic successes, China has one of the fastest growth rates. Given the existing growth rates, the expectation is that there will be more than 15,000 operational spacecraft by 2028.

More than 70% of the space industry is made up of the satellite market. While television and other services account for the majority of satellite earnings, there is still room for growth in other areas. Satellite imaging accounts for around $2.6 billion, or approximately 2%, of the current space economy. Another area is composed of the Remote sensing of the Earth (RS) satellites support sustainable development, resource management, and environmental monitoring and protection.

The market for Earth observation satellites is expected to expand at an average pace of 6.87% between 2022 and 2030, reaching $7.88 billion from a market value of $3.58 billion in 2021. The top operators in the market are private businesses, which includes American businesses Planet, Spire Global, and BlackSky Global. Chinese firms include Chang Guang Satellite Technology Company, while Argentine firms Satellogic and Finnish firms ICEYE Ltd, being in charge of over 55 % of the active satellites in orbit.

Numerous new private participants have entered the space market during the past ten years, and more and more businesses are joining them with fresh perspectives. Using 3D printing in zero gravity, setting up greenhouses on Mars, or doing mineralogical studies on the Moon are a few examples.

The massive growth in space activities has led to a growing demand for artificial intelligence solutions to be deployed in order to optimize the cost of space activities, in addition to enhancing financing opportunities for new ventures. The massive growth and engagement of the private sector requires solid regulatory frameworks in order to address these challenges and support the promotion of financing. Specifically, more and more individual and institutional investors are getting attracted by investing into the space sector, supporting new startup and established companies.

2. AI for the space industry

Due to the unique characteristics of space itself, contemporary technologies based on artificial intelligence offer a significant deal of promise for use in space operations. Despite the fact that the space era began more than 40 years ago, mankind has barely scratched the surface of outer space. Whether it be the launching of spacecraft, the installation of space modules, or the extraction of resources based on the Moon and other celestial bodies, all activities in space carry a significant danger of harm.

The use of autonomous systems, defined as systems devoid of human involvement in decision-making, are based on artificial intelligence and machine learning technologies. These are a type of AI that enables programs to predict outcomes more accurately without being explicitly programmed to do so and is viewed as a potential solution to a number of issues that arise during the space exploration process.

These technologies are already starting to be used in many facets of space operations, whether they be government programs or initiatives carried out through commercial partnerships, the share of which is growing. Examples include AILEO, an Artificial

Intelligence Learning Earth Observation system that automatically transmits information on land usage in almost real-time, or KubeSat, a project that offers the chance to construct and launch satellites using a variety of platforms. Another solution was created by Fujitsu, which employs artificial intelligence and computing techniques inspired by quantum mechanics to improve various components used in Active Debris Removal missions and other projects.

These include undertaking data gathering and analysis, managing space traffic, removing space trash, using resources, managing satellites, undertaking missions to planets, gathering samples from celestial bodies, etc. Deep learning, machine learning, artificial neural networks, deep neural networks, computer vision, and rule-based expert systems are just a few of the artificial technologies that are specifically employed in the space industry. These technologies are occasionally integrated with virtual reality and 3D printing.

The newest technological developments are intended to achieve Sustainable Development Goal (SDG) 9, which is focused on industry, innovation, and infrastructure, as well as to ensure the long-term sustainability of space operations. As a result, artificial intelligence technologies and space activities are high-tech, science-intensive fields, and the combined application of their successes can spur mankind to advance to a whole new stage of development, both in terms of space exploration and generally.

2.1. AI trends in space

Despite advancements in science and technology, it is important to stress that this area of activity, which carries significant hazards, is not adequately regulated by international law in general or international space law in particular. The outcomes of scientific and technological advancement should be used in a way that minimizes any potential negative effects, which means that the associated legal regulation should partially foresee occurrences [Girimonte, Izzo 2007].

This is especially relevant when considering artificial intelligence solutions. Here, it would be fair to draw attention to the crucial elements of the complete cycle of using artificial intelligence technologies in space operations that require a firm legal comprehension. The core question is what constitutes artificial intelligence and the legal definition of it. Another critical part is to pinpoint the applications of artificial intelligence technology that have the greatest potential for success as well as the associated dangers. Additionally, it aids in determining the likely legal repercussions of utilizing artificial intelligence technology in space operations and analyses solutions to regulatory issues.

The concept offers many methods for defining what artificial intelligence is. What was once thought to be more science fiction is now a reality. Since the dawn of time, people have pondered the question of whether machines are truly "machines" and if they can think at all. In the context of the growth of legal control of pertinent connections, the response to this question is extremely important [Oche, Ewa, Ibekwe 2021].

Despite differences of opinion on some points, the majority of legal experts concur that artificial intelligence refers to computer systems that resemble the human mind in some way. Robots and self-driving cars like Tesla are not examples of artificial intelligence technologies, but they are rather cognitive technologies that imitate the human mind.

In general, there are numerous ways to define the term "artificial intelligence”, including acting like a human (including the Turing test), thinking like a human (cognitive behavior modeling), and thinking and acting logically.

The so-called "weak" artificial intelligence or limited artificial intelligence, which imitates the cognitive process of humans, is the initial stage of artificial intelligence and the level of such technologies at which we are now operating. Such technologies are capable of producing spectacular outcomes, but they are also wholly "unaware of what they are doing". The next step is general or strong artificial intelligence, or AGI, which is on par with or even higher than human intellect and is capable of solving a large number of issues. The study of difficulties linked to the future deployment of this particular sort of artificial intelligence takes up a sizeable portion of the research that is now accessible [Zhang et al. 2023].

Within the context of the operations of international intergovernmental and non-governmental organizations, the issue of defining the term "artificial intelligence" is frequently raised. The terms "machine learning" as well as "artificial intelligence" are also commonly used in research. Representing a subset of artificial intelligence, machine learning describes a network of computer programs with overlapping features. These technologies may execute a variety of activities and provide efficient automated solutions by analyzing a vast quantity of data, identifying the essential patterns, and applying the findings.

The outcomes are comparable to those of intellectual endeavor. The capacity of a computer to perform better without being specifically taught to do so is referred to as machine learning. Machine learning is now the most important and successful strategy in the development of artificial intelligence technology. The majority of the current artificial intelligence systems that have an impact on modern civilization are based on machine learning.

2.2. Definition of AI

It is crucial to start with the fact that the terms intelligence and learning are employed metaphorically rather than in their literal sense when discussing terminology concerns (artificial intelligence, machine learning). Modern artificial intelligence systems do not actually think or act as people do. Similar to humans, machines cannot learn. These technologies have the ability to reach logical (intellectual) conclusions without the need of intelligence as we understand it to apply to individuals [Arrieta et al. 2020].

Since these technologies do not produce results in the same way as the human mind, they merely imitate mental activity in such a way that a computer makes a decision that is most appropriate for the given circumstances (algorithms) based on the information received and the recognized patterns. This is why the terms imitation or simulation frequently appear in the proposed definitions. These algorithms have demonstrated their effectiveness in carrying out tasks with precise and well-defined parameters that do not call for abstract thought, as is the case with the human mind.

Without discussing the possibility of "strong" intelligence systems developing in the near future, it should be highlighted that present technologies are typically associated with "weak" intelligence and are designed to only address a limited range of issues with a certain set of features. It is essential to comprehend this if legal regulations are to be developed for the usage of such technology generally and in the space sector specifically [Talimonchik 2021].

The subject of an artificial intelligence system's potential legal personality, notably in the context of international law, is becoming more and more important as these systems grow in complexity and influence more and more aspects of society. These factors form the foundation of this query. The establishment of legal responsibility for the occurrence of negative outcomes as a result of the use of artificial intelligence is the first and fundamental legal issue associated with the usage of such systems. The second challenge is how to reap the rewards of using artificial intelligence, particularly in terms of protecting intellectual property rights [Chesterman 2020].

The Turing test is thought to be the beginning point for evaluating when a computer has attained the appropriate level of autonomy, which is similar to a person. For instance, the European Parliament urged the Commission to consider establishing a specific legal status for robots in the long run, so that at least the most sophisticated autonomous robots could be established as having the status of electronic persons responsible for making good any damage they may cause, in its resolution with recommendations to the Commission on civil law rules on robotics from 2017 [Singh, Lomash 2021].

The issue of whether a machine is responsible for its own acts has only recently come to light since, up until that point, it was only seen as an item or tool used by the person who designed or programmed it. This strategy is conventional and does not call for any modifications to the current legal rules. However, when these technologies become more widespread over time, taking into account advancements in science and technology as well as the shift from automated to fully autonomous operations, a new dilemma develops. Here, we imply that autonomy denotes the capacity to make judgments without human input while automation denotes real-time human control.

There is the suggestion to establish these technologies' legal standing by analogy with animals, i.e., as legal objects endowed with legal personality, because they are capable of conducting autonomous activities.

There has also been a far more contentious approach proposed, in which artificial intelligence is viewed as a full-fledged topic of legal relations. In case that the artificial intelligence system reaches autonomy at the human level, then it may be equivalent to a status of a person. This relates to the legal status of evidence in support of their claim that artificial intelligence has a status comparable to that of a legal entity. Specifically, autonomous systems can be likened to legal entities and that, in accordance with US law, it is possible to establish a limited liability company that is entirely run by artificial intelligence, demonstrating that such a structure gives AI legal personality [Čerka, Grigienė, Sirbikytė 2017].

This approach raises some issues and is criticized on the grounds that, first, such a comparison is incorrect because people are always behind such an entity's activities, and, second, because of the lack of a consistent approach to resolving this issue, it is possible for such legal entities to evade the law and abuse their rights if they engage in illegal activity. Such apprehension is well-founded because such organizations can be established across state lines, which can make it much harder to stop them from engaging in illicit activity if local laws have distinct regulatory frameworks.

Another view, which appears more plausible, states that a system with artificial intelligence components and a system that is entirely autonomous should have different legal statuses. Autonomous machines are capable of being acknowledged as full-fledged cyber subjects of society, but the scope of their rights and obligations should vary depending on how they function. Additionally, some scientists refer to this idea as an electronic person in which artificial intelligence plays a crucial role. Therefore, an electronic person can be granted some rights and obligations as the owner of artificial intelligence, or have a mind that is comparable to a human's and the ability to make judgments that are not predetermined by the algorithm's developer or operator [Solaiman 2017].

However, even though artificially intelligent machines can arrive at what is referred to as reasonable results based on data through independent decision-making, as such, they are not related to intelligence or reason in the direct (human) sense of the word, since the human cognitive process when making a decision occurs in a completely different way. Therefore, this capability of smart robots cannot be compared to the ability of a person or a legal entity to make decisions. This implies that decisions and acts taken by artificial intelligence, which is not under human control, do not take a variety of human characteristics including consciousness, emotion, and discretion into account.

Currently, it is challenging to discuss the potential benefits of using artificial intelligence in space. Although artificial intelligence technologies, particularly machine learning, are still being developed for the space sector, one can already see how these components are being gradually incorporated into space activities.

One example of how artificial intelligence technology can change space activities is remote sensing satellites. The necessity for data processing has significantly increased with the deployment of the most recent satellite technology, such as Copernicus or Smart Sat. The ground station receives the data that the satellites have collected. A new age in working with information and data may begin with the employment of artificial intelligence technology both on Earth and in space. Artificial intelligence will enable the satellite to quickly examine and process the data it receives before transmitting only the most pertinent and necessary data. This will lower transmission costs and free up resources for the analysis of the most crucial data [Dremliuga, Kuznetcov, Mamychev 2019].

2.3. Applications of AI in space

Artificial intelligence will have an impact on all facets of the space business, from launch to constellation control and satellite performance evaluation. There are several applications that apply AI algorithms to satellite Earth Observation (EO) photos. Additionally, in the not-too-distant future, artificial intelligence will be used in some capacity for the majority of satellite service operations. As a result, artificial intelligence-based satellites will eventually become more autonomous and lower the amount of data that is transmitted from space to Earth [Kumar, Tomar 2018].

AI is actively employed to monitor the performance of space objects, the activities of other satellites, planets, and space debris, and, if necessary, to take corrective action. For instance, SpaceX employs such mechanisms to stop satellites from crashing into other objects. The helper robots for the crew of space stations are another example of artificial intelligence being used in space. CIMON's assistance robot or the SpaceX robot are such examples. CIMON helps astronauts with their daily tasks, with finding papers and information, and with using and maintaining station equipment [Fourati, Alouini 2021].

The use of artificial intelligence technologies is increasingly necessary while investigating potentially hazardous areas of space for people. In order to investigate Mars, the NASA rover was launched. With the use of artificial intelligence, rovers may gather and examine data and choose for themselves what information to send back to Earth and what tasks can be completed without the help of humans. Since 2016, NASA has tested the AEGIS autonomous system on a rover that was assigned to explore the Gale Crater on Mars with the intention of identifying and photographing boulders [Lu et al. 2023].

Additionally, NASA established the Artificial Intelligence Group, which carries out fundamental investigations into the planning capabilities of artificial intelligence employing scientific analysis, spacecraft operation, mission analysis, deep-space network operations, and space transportation systems. NASA is looking into the prospect of creating more autonomous spacecraft for deep space travel so that decisions can be taken instantly and without delay, as opposed to having to wait for a signal to be transmitted.

Separately, it is important to note the application of cutting-edge technologies for the elimination of space junk. The ClearSpace-1 mission, which will be the first space debris clearance mission ever launched by the European Space Agency (ESA), will have an AI camera to find junk [Ma, Yang 2016].

Deep space exploration has new possibilities thanks to the advancement of artificial intelligence technologies and their integration into space operations. It is extremely challenging for operators to transfer information from space to Earth due to the vast distances in space. In these situations, the challenges are not just about gathering data and processing it, but also about providing straightforward support in the event of a breakdown of equipment or a problem on board. This is hampered by poor accessibility to the equipment. Intelligent systems that are capable of problem prediction, diagnosis, and independent decision-making may be the answer to such issues.

The development of artificial intelligence technology occurred in a sort of normative vacuum up until recently, and today there are still very few regulations that specifically address this issue. As part of the Committee on Space's activities, concerns about the use of artificial intelligence technologies in space are becoming more and more prevalent. In particular, the processing of satellite imagery with artificial intelligence to produce highly accurate and quickly accessible information on crop yields, and an autonomous astronaut assistant with artificial intelligence are such examples. Unfortunately, the Committee's and its subcommittees' meetings' agendas do not yet include a distinct discussion of artificial intelligence.

3. Space law regulations

The rapid development of technologies in this field, which has the potential to significantly impact the process of space exploration and the diversification of types of space activities, has created a need for a separate understanding of issues related to the use of artificial intelligence in space activities at the international legal level. Separate national legal initiatives are already taking shape at the state level in this area, which, on the one hand, helps to develop legal regulation but, on the other hand, has the potential to give individual state interests the upper hand when engaging in activities in outer space [Jasentuliyana 1989].

Particularly, several states started unique initiatives through their national space agencies a long time ago with the aim of advancing research and technology in the area of artificial intelligence. There are plans to establish a federal agency for artificial intelligence in the US that would flexibly, completely, and intelligently regulate artificial intelligence, among other things. For obvious reasons, the current international space treaties, which were adopted in the 1960s and 1970s, do not include provisions limiting the use of artificial intelligence technology and instead define only basic guidelines for all activities in space and on celestial bodies.

Space is not subject to national appropriation in general, and space activities are carried out in accordance with international law. Furthermore, states are responsible for all national activities and the space activities are based on the principle of cooperation and the requirement to take due account of the relevant interests of all other states. Finally, the states should inform the public and the international community of their activities. The use of artificial intelligence technology is not covered by any soft law acts, which are important in regulating space activities [Adams 1968].

The absence of specialized regulation in this domain is risky since it could lead to the formation of numerous challenging scenarios in the future, given the characteristics of artificial intelligence and its potential applications. In particular, problems about data protection, transparency, non-discrimination, cybersecurity, intellectual property, international accountability and liability, and other topics are raised by the growing use of artificial intelligence technologies in space activities.

Artificial intelligence-based autonomous systems in space activities will inevitably have legal repercussions, particularly in terms of liability. The 1967 Outer Space Treaty's Articles VI and VII and the 1972 Liability Convention's Articles II and III are principally responsible for regulating liability problems. The provisions of general Article VI, which establishes states' liability for an internationally wrongful act, and the provision of Article VII, which is clarified by the provisions of the 1972 Liability Convention, form the foundation of the liability regime under the 1967 Treaty. Article VI uses the term responsibility, which refers to international legal responsibility generally, which may not always imply that any harm was done [Muñoz-Patchen 2018].

Therefore, the launching state bears international responsibility in accordance with Article VII of the Outer Space Treaty. A state that launches or arranges for the launch of an object into space, or a state from whose territory or facility an object is launched, is referred to as a launching state. The Liability Convention's Articles II and establish a regime of absolute liability, which is also called objective liability, for damage brought about by a space object on Earth or by an aircraft in flight, and liability based on fault for damage brought about in outer space or on a celestial body, detail the provisions of Article VII of the Outer Space Treaty.

The location of the damage, whether on the surface of the Earth or elsewhere, is the determining factor for assessing culpability. Additionally, as non-state actors are not subject to the same accountability requirements as governments under international space law, only states are responsible. Artificial intelligence technology advancements open the door to sophisticated operations in the notoriously dangerous environment of space. There are several issues with regard to the application of accountability for harm brought on by the usage of such technology in space [Johnson, 2018].

3.1. Liabilities in space law

First off, there is no definition of fault under the Liability Convention and no established standards for judging fault. It can be challenging to determine blame in a specific situation under Article III, and the Liability Convention has never been used in any documented instances of damage to spacecraft caused by collisions. Additionally, establishing fault requires that norms for due care exist, which is hard when deploying such cutting-edge technologies. In this instance, it also seems to matter how much the usage of artificial intelligence contributed to the harm [Reis 1978].

Therefore, it is of importance to ascertain when and how much such technologies were utilized in the execution of space operations to determine whether the harm was caused by decisions made using artificial intelligence or based on information obtained using such technologies.

Questions are also raised by the usage of the word persons in Article III of the Liability Convention. When referring to an entity with rights and obligations under the law, such as a natural or legal person, the term person as used in Article III refers to this (Forkosch, 1982).

In a broader sense, liability for damage under Article III refers to all individuals and types of space activities that are considered to fall under the purview of Article VI of the Outer Space Treaty, according to the commentary on the article. This liability refers to a group or category of people for whom the launching state is responsible. It is also impossible to interpret the Convention in a way that limits the scope of its application if there has never been a prior interpretation of the concept of responsibility for space activities and the process for establishing such responsibility. This is because doing so would run counter to the Convention's goals and objectives, which were outlined in the Vienna Convention on the Law of Treaties, 1969.

The article's commentary also points out that, in fact, everything will depend on proving that the launching state was at fault and using the available tools for proof. Given the foregoing, it is difficult to see how a choice made by an intelligent space object could be considered to be fault given that liability under Article III of the Liability Convention calls for the establishment of fault of the state or fault of persons. This means that it will be difficult to hold the launching state accountable for the harm caused by such an object in the case of a collision.

In addition, states are absolutely accountable for any harm their space objects make to the Earth's surface, as stated in Article II of the Liability Convention. There are currently no barriers to punishing states specifically for their use of artificial intelligence technologies. The difficulty in carrying out this obligation arises from Article VI of the Convention, which allows for the abolition of the strict rule under Article II in the event that a launching State establishes that there was significant damage. This has either resulted in total or only as a part of the gross negligence, or may be in the form of an act or omission that was with the intent to cause damage. The damage has to be claimed by the State or the natural or juridical person to whom it provides the representation [Von Der Dunk 2011].

For an artificially intelligent object, such an exception is virtually unheard of. Both the Convention and its commentary, which simply mentions the standard of care, fail to define the term gross negligence. The first premise is that gross negligence has at its core a mental component and is the product of human mental activity, which, in theory, cannot be typical of computers. As a result, it is exceedingly difficult to apply the relevant articles of the Convention because there are no defined standards for the standard of care and because they are determined by the state of scientific and technological advancement.

Another issue in this regard is the fact that not all space-faring nations have reached the appropriate stage of development to make use of artificial intelligence tools. It is debatable whether it is viable to govern state actions in this situation in a similar manner or whether it is essential to create rules that allow for this variation in the form of a so-called sliding scale based on technological capabilities.

Although using artificial intelligence technology can have many advantages, there are also some ethical and social hazards that come with their development. For instance, using artificial intelligence and space technology together in law enforcement agency operations is a serious problem [Quinn 2008].

3.2. Legal challenges of utilizing AI in space

Without a doubt, advances in artificial intelligence and space technology can aid in the prevention or resolution of crimes, for instance, when satellite photos enable the suppression of illicit drug cultivation. The employment of such technology may also be utilized to infringe on ethical aspects, such as human rights.

The misuse of technology can potentially result in significant harm, harm that can be both material and intangible. Material damage may be in the form of damage to human health, including potential death, while intangible damage may be a restriction of the right to free expression and discrimination.

Since there are many prospects for the deployment of such technology in this field, the effects of their employment in space pose some considerable challenges. These concerns are also connected to the fact that in recent years, new private legal entities have played an increasing role in space activities, which are primarily governed by national legal norms.

There are two aspects of using artificial intelligence technologies that cause most of the potential ethical and legal challenges. The first one is about ensuring the privacy and security of personal data, and the second is the improper data storage. In particular, the prevalence of facial recognition, and lack of transparency as well as tracking and de-anonymizing data represent some challenges. In terms of transparency, the data subject may not be sufficiently informed about the data collected about them. Furthermore, the lack of access rights and the requirement for the correction and deletion of data may face challenges. Finally, bias and discrimination, and unreliable results may represent a concern [Bratu, Lodder, Van der Linden 2020].

There are several regulations intended to address the difficulties mentioned. The General Data Protection Regulation of the European Union is one of the key regulations that has been pushed forward. According to the Regulation, personal data refers to any information on an identified or identifiable person that is derived through observation of the Earth, including that person's location. The data subject shall not be subject to a decision based primarily on automated processing, including profiling, that creates legal effects concerning him or her or that similarly materially affects him or her, according to Art. 22 [Forkosch 1982].

The sharing of various technologies, which might result in significant human rights breaches, may represent another legal challenge. For instance, data from Earth observation can be merged with data from security cameras, facial recognition technology, and location data for analysis. This poses severe concerns about maintaining the secrecy of the data. In this regard, it is important to take note of the Convention for the Protection of Individuals with regard to Automatic Processing of Personal Data (No. 108), which was adopted within the Council of Europe framework. This convention starts with a broad interpretation of the term personal data and establishes the acceptable usage restrictions for face recognition technology. Only this Convention provides for data protection, and any state may join it.

Additionally, the UN acknowledged that human rights should be evaluated at the conception stage prior to the widespread adoption of facial recognition technologies. The problems with data storage are examined individually, particularly the issue of the absence of a clear legislative framework for business activity, which frequently disregards the defense of human rights. These issues are a major source of worry given the expanding involvement of the private sector in space activities [Adams 1968].

More and more initiatives are coming from non-governmental organizations and academia, which are also actively developing solutions to the problems that have been recognized.

Given the increase in activity in this area, it is important to carefully consider the alternatives that have been suggested and, first and foremost, to adapt the standards and guidelines for the protection of human rights and the privacy of personal information that currently exist. Because various areas of interstate cooperation are interconnected, it is crucial to concentrate efforts on creating an intersectoral strategy that will take into consideration the unique characteristics of space activities and, to the greatest extent possible, guarantee the respect and preservation of human rights. This represents a key criterion when evaluating the financing of space operations by private companies, and the evaluation of the potential risks arising from the financing agreements [Reis 1978].

The space industry and related activities are now developing quickly. The share of the private sector in space activities has grown dramatically during the past few decades, along with the number of states participating. Unprecedented potential for space exploration and the deployment of new kinds of space operations have been made possible by the development of artificial intelligence technology. State-sponsored and private players alike are launching increasingly sophisticated and intelligent spacecraft that can operate autonomously thanks to advances in artificial intelligence technology. These gadgets are particularly useful for tracking satellite activity, serving as astronaut aides, and carrying out research in potentially dangerous environments.

In addition, there are some legal repercussions associated with the use of artificial intelligence systems in space activities. Unpredictable outcomes may result from the employment of space technology that are fully independent of humans, raising significant problems that the international community must address [Dremliuga, Kuznetcov, Mamychev 2019].

Since it's crucial to know what the subject and object of a relationship are in order to effectively manage it, defining the essence of the term artificial intelligence is the first and most difficult challenge. Different techniques of categorizing artificial intelligence are also included in the doctrine and individual legal acts based on the level of human control and other considerations.

Second, there is currently no consensus regarding the legal standing of AI. Artificial intelligence is an independent personality that makes decisions based on its capacity to learn independently due to its character that is autonomous from humans. Applying the current legal classifications to establish the status of artificial intelligence in this situation is improper. Different responses may be suggested by the question of whether artificial intelligence can be regarded as a separate legal subject.

Thirdly, there are hazards associated with using artificial intelligence in space activities that are distinct from those that arise when using similar technologies on Earth. This is caused, in part, by the characteristics of space, where any activity is hazardous in and of itself. The international community needs to concentrate its efforts in this regard on the creation of specific regulations pertaining to the use of artificial intelligence technology in space.

Last but not least, neither the 1972 Convention on Liability for Damage Caused by Space Objects nor the 1967 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, address concerns arising from the potential use of artificial intelligence technologies. States will have to decide whether creating a new international treaty, amending an existing treaty, or adopting an interpretative declaration is the best course of action to settle disputes brought on by the use of artificial intelligence technologies in space activities, at least temporarily. At the same time, activity linked with space is understood to include both activity in space and activity on Earth. These challenges have a considerable impact on financing of space activities and characterize the potential legal financial risks [Forkosch 1982].

4. Asset-Based Financing for Space

Space exploration and operations have complex requirements regarding its financing. Specifically, the securing of financing is governed by the respective national regulations, which may differ significantly between the nations where the operations take place. Security interests are supported strongly in some jurisdictions but less so in others. Since security interests are governed by the law of the State where the property is located, security interests may lose their validity when highly valuable mobile equipment is transported from one nation to another or launched into space. This is especially true for launches into space, where it may be under the jurisdiction and control of a different State than the one whose law applies to the security interest. This has led to the development of an independent international interest in order to reduce the risks and expenses involved with funding expensive mobile equipment [Cahan, Marboe, Roedel 2016].

As a result, the Cape Town Convention creates an independent worldwide interest in a variety of high-value mobile equipment types, including rolling stock for railroads and space assets. This interest is safeguarded by registration in an international registry. Additionally, it offers protection against the loss of the security interest in the event of a change in jurisdiction and clarification regarding the applicable law.

In 2001, the Cape Town Convention was approved in Cape Town, South Africa, and established the fundamental guidelines. The Protocol to the Convention on International Interests in Mobile Equipment on Matters Specific to Space Assets (Space Protocol), the third and final asset-specific Protocol to the Cape Town Convention, was approved by 40 States at a diplomatic conference on March 9, 2012, in Berlin, Germany. By taking into account the unique characteristics of space financing and the unique context in which space activities are conducted, it adapts and clarifies the broad guidelines outlined in the Cape Town Convention [Papazian 2022].

The Cape Town Convention system works by lowering a creditor's risk and improving legal predictability in the transactions covered by it, allowing for safer and more affordable sales of high-value assets. The Space Protocol was created to enable more secure transactions in space assets because its Protocols are customized to satisfy the unique financing demands of various businesses. The Cape Town Convention system enables the formation, registration, and enforcement in Contracting States of priority rights in high-value assets of a registrable type through the establishment of several international registers under each Protocol. This makes asset-based lending and leasing more predictable within certain industries, enabling lenders to offer credit with assurance and at cheaper rates.

The Cape Town Convention Protocol's main goals are to make it easier to buy and finance economically significant pieces of uniquely identifiable mobile equipment by allowing for the development and promotion of international interest that will be acknowledged in all Contracting States. Additionally, it offers the creditor a number of fundamental default and insolvency-related remedies as well as a way to get quick relief in the event of a default while waiting for the merits of its claim to be finally decided.

Additionally, it aids in the creation of an international electronic registry for the registration of international interests, which notifies third parties of their existence and permits the creditor to maintain their priority over later registered interests as well as unregistered interests and creditors in the event of the debtor's bankruptcy.

Finally, it shall ensure that the specific demands of the relevant industry sector are satisfied through the pertinent Protocol. A Space Asset is defined in Article I(2)(k) of the Space Protocol as a uniquely identifiable asset that is man-made and is utilized in space or for the purpose of the launch in space. This has to comprise a spacecraft, a payload, and any associated parts. The spacecraft may be a satellite, space station, or any other space module. The payload represents telecommunication, navigation, or any observation, and the part of the spacecraft may be a transponder. These are all matched together and the entirety represents a space asset.

All space objects, including those that are frequently used by businesses in the space sector, are covered under the aforementioned definition. It has given the Regulations of the International Registry (hereinafter "Space Registry Regulations"), to be established under the Space Protocol, discretion to decide upon the inclusion of types of payloads, and parts, as appropriate, after consulting with the industry. It is also aware of technological advancements and developments within the space industry.

As a result, up until the draft Space Registry Regulations are revised, the Space Registry will only accept registrations for spacecraft and transponders or other communication equipment. This is consistent with the way that the space sector currently finances the leasing of satellites and satellite transponders. The Space Registry Regulations may, however, change this in the future if it becomes necessary.

In the event of default, a creditor may exercise its ownership rights over the asset by relying on the default and insolvency remedies provided under the Cape Town Convention System. These include temporary relief such as the preservation of the asset while the complete remedies are being used, taking ownership of the charged object, selling or leasing the object, or collecting any income or profit derived from its management or usage. The Space Protocol allows Contracting States to choose between two Alternatives for the ultimate implementation of the right to asset seizure. The expediency and formalities of enforcing repossession or correcting the default vary among these options [Cunningham 1985].

Public services that are absolutely necessary are frequently provided using space assets. It was decided that a creditor shall not exercise its rights in a manner that would render the public service inoperative before the expiration of a period (between three and six months to be declared by the Contracting States at the time of ratification) in order to ensure the continuation of these services. Which services are required for the delivery of public service are left up to the national laws of each Contracting State.

If a service is recognized as such under the laws of the relevant Contracting State, the service provider or the Contracting State may submit a public service notice to the International Registry, which may restrict the use of the default remedies mentioned above.

It is recognized that security interest-protected space assets may be physically connected to other space assets. According to the Protocol, default remedies cannot be implemented in a way that interferes with the functioning of another asset if that asset is the subject of a prior international interest or sale [Clancy, Voss 1998].

Priority can be obtained by registering the other assets, which are assumed to form an interest at the time of registration, within three years of the Convention's (and the Protocol's) effective date. This makes it possible to effectively protect current assets.

Salvage is a right or interest that accrues to the insurer upon the settlement of a loss involving a space asset and is based on, relates to, or is generated from that asset.

When financing space assets, insurance is a crucial factor. The Space Protocol aims to prevent the Protocol from having an impact on this area of the sector. In order to achieve this goal, Article IV(3) specifically specifies that neither the Convention nor the Protocol may alter the legal or contractual rights of an insurer to salvage in accordance with the relevant law.

As a result, neither the Convention nor the Protocol affects salvage rights, including rights via subrogation, and any conflict over precedence between salvage rights and creditor rights shall be decided in accordance with the prevailing legislation.

The practical challenges of physically reclaiming space assets were expressly considered when writing the Space Protocol. The Tracking, Telemetry, and Control (TT&C) of space assets, which may be found inside the command codes related to it, was therefore given special consideration by the drafters. Satellite command codes serve as encryption keys that enable satellite control. To give the creditor a chance to take over or operate the space asset remotely and effectively exercise its rights as granted by the Space Protocol, Article XIX enables the parties to an agreement to expressly agree to the placement of command codes and related data and materials with a third party [Nelson 2021].

However, Article XXVI(2)(c) limits Article XIX in that the placement of command codes with third parties may be prohibited, restricted, or subject to other constraints under the laws and regulations of Contracting States.

5. Financing risks of asset-based space activities

The amount of money needed to finance space-related initiatives has recently expanded dramatically, with the global space economy already exceeding USD 350 billion in 2017. The Space Protocol proposes a new method of obtaining funding that is now only sometimes employed in the space business. Through the Cape Town Convention's Aircraft Protocol, which has generated billions in benefits since going into effect in 2006, this mechanism has already demonstrated its value to the aviation industry.

Given the unpredictability of space and the generally high capital requirements for any space enterprise, which frequently begin with pricey research and development efforts, investment in the space industry carries a far higher degree of risk than investing in other industries. Establishing standard regulations controlling investments through the implementation of a security package that can be improved and enforced at a cheap cost is one strategy to lessen investor risk and uncertainty. By doing this, the default risk will be reduced, and the creditor's confidence in getting their investment back will increase.

Recently, there has been a significant influx of start-ups and new entrants into the space business, generally referred to as NewSpace. These businesses, which primarily operate as small businesses with solid business plans, hope to make money by using space applications or engaging in space exploration. Their services and products rely on the usage of cutting-edge, ground-breaking technology that would be utilized in space [McCurdy 2019].

A commercial enterprise must first spend money on various essentials to establish its business in order for it to expand and become profitable, which typically necessitates borrowing money from a source that is open to it. The potential lender or creditor will first try to determine whether their money is likely to be repaid before choosing whether to grant credit. For this, they will consider the company's reputation and do a risk analysis for their investment.

Since the majority of NewSpace start-ups lack the AAA credit ratings that their conventional, well-established space counterparts do, creditors are reluctant to lend to them at competitive interest rates. The risk associated with investing in start-ups, such as those in the NewSpace industry, is plotted against the typical funding cycle of a start-up in the accompanying graph.

By granting creditors rights in their assets, asset financing enables businesses to leverage their assets and obtain funding. The advantage of asset-backed financing is that if the debtor is unable to pay back the creditor's loan, the asset itself or an interest in the asset may pass into the creditor's ownership or control. In this way, the debtor will repay a portion of the credit the creditor gave to them. In cases where the business collapses, and the creditor would otherwise receive little to no return on their investment, this is more appealing to a creditor than offering the business's earnings.

The Space Protocol can significantly lower the investor's risk in the financing cycle described on the previous page at the point where the idea has materialized and can be perceived as an asset. Creditors may be ready to purchase rights within this technology (asset) in exchange for liberal lending terms when the start-up reaches the stage when it can demonstrate its technology to investors and create it, either internally or with the assistance of external manufacturers. Asset-based financing may be preferable to other ways of raising finance depending on the specifics of the project and the preferences of the stakeholders.

The Space Protocol greatly facilitates these kinds of transactions in such a way that it lowers the riskiness of the extension of credit by increasing the likelihood that the amount loaned will be repaid in the event that the debtor goes bankrupt; and that it lowers the burden on the creditor to watch out for the debtor evading the credit because the creditor now only needs to watch out for the asset securing the loan and not the debtor's enterprise's overall operations and profitability [Larsen 2013].

The Space Protocol increases the security and confidence of lenders to engage in the space industry by establishing an international registry where interests in space assets can be recorded and confirmed. The Space Protocol further secures the investment and permits creditors from all over the world to invest capital in space assets, including and particularly in cases of cross-border movements and entities from different States, as is typical for space projects. The Space Protocol also introduces a robust set of internationally recognized and thus enforceable remedies in the case of a default.

The Space Protocol makes sure that these secured transactions are subject to a uniform set of international regulations. This makes sure that when creditors invest in space industry projects abroad, they do not have to be concerned about a variety of restrictions. Additionally, this guarantees that the finance contract will not be significantly impacted by the asset's location in space. Additionally, because most start-ups only have their idea or asset to use as collateral, relying on their work and technology instead of selling their stocks or taking out loans with exorbitant interest rates allows them to acquire financing [Larsen 2013].

Asset finance is a very alluring choice for investors wishing to contribute cash to the space sector because of the priority and security of their interests in space assets and the use of a robust system of remedies. It resolves the problems caused by the numerous incompatible laws that apply to secured transactions of global scope as well as those concerning asset rights. To make sure their investments are free of pre-existing third-party interests, prospective creditors within the same asset can also quickly search the online registry.

6. Conclusion

The space industry has grown significantly in importance, with more and more private companies aiming to provide services within the space environment. These include space tourism, in addition to the extensive deployment of satellites for earth monitoring, communication, and space exploration. Technological developments have accelerated the ability of private companies to provide services and establish businesses in the space area, with several new businesses providing services across the world. With the technological advances in AI, the space area has been an important area for AI to be deployed, but also the challenges that it may face. The challenge with AI in the space sector and regulations in the space sector overall is the global regulatory nature of the environment. This is especially challenging given that there is a significant discussion regarding national AI regulations in order to deal with this fast-developing area. Based on the challenging regulatory environment and the associated risks, financing these new business models has presented new complexities that have to be taken care of. Asset-based financing of such operations represents key opportunities in order to deal with the intricate complexities of such operations and the various legal environments. While liability and other challenges have to be considered both in light of national and international regulations that may have to be taken into account, asset financing represents a very attractive option given the priority and security of the interest in the space asset. Specifically, there are various remedies given that it reduces the risk of various non-compatible regulations in order to secure their concerning asset rights. Furthermore, pre-existing third-party interests can be typically looked up via online registries, hence reducing potential risks.

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