Jayakumar
Venkatesan
Chief Executive Officer, Valles Marineries International Private Limited
e-mail: jkaeroautics@gmail.com

CHALLENGES IN SPACE RESOURCES EXPLORATION, EXPLOITATION AND UTILIZATION OF MOON-MARS

Abstract

The development of space as an arena for multiple government and private activities will pose significant policy and legal challenges. The legal framework for space activities is based on the 1967 Outer Space Treaty and four subsequent United Nations treaties implementing its provisions. These agreements were negotiated at a time when governments were the principal players in space and commercial space activities were in their infancy. Whether they form an adequate and appropriate framework for current and future space activities requires review. Several nations are currently engaging in or planning for robotic and human space exploration programs that target the Moon, Mars and near-Earth asteroids. These ambitious plans to build new space infrastructures, transport systems and space probes will require international cooperation if they are to be sustainable and affordable. Partnerships must involve not only established space powers, but also emerging space nations and developing countries; the participation of these new space actors will provide a bottom-up support structure that will aid program continuity, generate more active members in the space community, and increase public awareness of space activities in both developed and developing countries. The integration of many stakeholders into a global space exploration program represents a crucial element securing political and programmatic stability. The Outer Space Treaty prohibits the deployment of weapons of mass destruction in outer space and on celestial bodies. Other treaties have limited some military activities in space, but there is no general framework regulating the military uses of space. The wisdom of developing space weapons—or, alternatively, of limiting their development and keeping space a weapons-free environment—is an issue for discussion and debate.

1.Introduction:

With the remarkable development of space technologies, space mining—also labelled “space resource utilization”—is about to become a reality that must be acknowledged into the law. It is all the more urgent since the current debate at the United Nations (hereinafter UN), as well as the divergent opinions expressed by legal experts in different forums, show that the current international legal framework is insufficient to regulate this emerging industry. At stake, from a legal perspective, are first and foremost the challenges linked to the res communis nature of outer space as it is enshrined in the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (hereinafter Outer Space Treaty). Under the res communis regime, outer space is open to all countries for access and use on the basis of equality. Consequently, States are free to conduct activities in outer space, including the Moon and other celestial bodies, without having to ask prior permission to other governments. One limit however is the so called ‘non-appropriation principle’ which derives from outer space belonging to the international community: one cannot simply claim exclusive ownership rights over outer space or part of it. But for the first time since the beginning of the Space Age, space faring-nations and private entities are actively seeking to venture into outer space for its natural resources. The Moon and other celestial bodies, such as Mars and asteroids, contain an

abundant amount of resources that are scarce or non-existent on Earth, such as the isotope Helium-3 or useful metals like nickel and platinum. Recent studies estimate that the "value of each asteroid could be somewhere in the trillions [of dollars] or higher". It is thus with no surprise that we witness the enticement of the private sector for these profitable future prospects; even more so now that the technology to reach and mine outer space is about to become available. This article is narrowly tied to emerging issues linked with these new possibilities and the resulting legal needs they entail as shown by recent international events.

2. Space Law

The United Nations Office for Outer Space Affairs (UNOOSA) defines space law as 'the body of law applicable to and governing space-related activities'. This definition can also be found as applied by other institutions. There are different sources of space law: international treaties (including the five treaties from UNOOSA), Customary International Law, soft law (including the five principles governing outer space from UNOOSA), national law, case law, … In this thesis, the focus is laid on the treaties and principles given through UNOOSA and Customary International Law. These form the basic and most important sources of space law and are the necessary instruments to look for an international exploitation regime.

3.Commercial Space Exploitation

Commercial space or commerce can be defined by its goal: to make profit through sale. Commercial space activities can then be defined as: activities performed in space in order to create products and/or services where the main result is to make profit through the sale of them. Three remarks can be made concerning this definition. First, it is important that no distinction is made between private commercial activities and public commercial activities. It is not a necessity that a private company solely performs the commercial activity. Secondly, not the whole activity needs to be performed in space. GPS navigation can be seen as commercial space activity because of the use of satellites in space. The fact that the end product is a GPS bought by a consumer on earth does not mean that there is no commercial space activity. At last, there can be room for other goals besides merely making profit. Exploration and scientifically experiments can be conducted while performing commercial activities.To conclude, commercial space exploitation in this thesis is defined as: the action of making use of and benefiting from resources that are exploited in outer space where the main goal consists of making profit through the sale of products and/or services. In this definition, it is not clear what 'outer space' exactly entails. This will be addressed when defining 'celestial bodies'.

4. Resources on Celestial bodies

In the following part the riches of the Moon and other celestial bodies will be addressed and practical appliances will follow to illustrate the commercial interest in outer space. This part is only meant as a means to show the potential commercial interest in celestial bodies and will only touch the resources of celestial bodies on a high superficial level.

5.The Moon

The source of the commercial interest in the Moon clearly is Helium-3 (He-3). This is a rare element on earth, due to the fact that the protection of the earth's atmosphere against the sun's solar winds prevents He-3 from reaching earth. The Moon, however, doesn't have any atmosphere and has been absorbing He-3 into its rocks for over many years. He-3 could be of great use in the medical world to provide e.g. non-radioactive lung imaging, but more importantly it could be used as a great energy resource. The advantage lies in its pollution-free features. It could be used in

nuclear fusions as no pollution of radioactive by-products is generated. This means that environmental friendly energy plants could replace the now highly controversial nuclear plants. He-3 could evidently also be used on the Moon itself as an energy source for several activities or for activities departing from the Moon.

However, there is one problem with He-3. Currently, the technology being used in nuclear energy is called nuclear fission, which consists of splitting atoms. Yet, to get nuclear fusion energy, which consists of the fusion of atoms, a huge amount of temperature is needed, which is not easy on earth. He-3 is a great source for fuel for the latter, nuclear fusion. In other words, He-3 is the fuel for a technology, which is not yet developed fully. For now, there is only a small reactor in place for fusions involving Helium-3, but currently, it is not been able to generate net power output and has only been used for scientific research. Other resources on the Moon are also present on earth itself (calcium, silicon, aluminum, iron titanium,). These can be used in our daily life but more importantly they can be used for activities on the Moon itself. Iron and aluminum can be used for construction goals, while silicon is of great value in the production of computer chips, lenses and fiber optics.

6. Planets and their Moons

In our solar system, there are seven other planets, excluding earth. Over the last years, the planet Mars has gained a lot of attention in the context of possible colonization and space agencies have been interested in Mars all along, as has already been shown through the robotic exploration of the planet . Mars, however, could also be interesting from an economic point of view. Lots of rare metals are abundant on Mars (zinc, iron, sulphur,.),which are of great value on earth. The planet Mercury also has minerals that could be of great use (iron and titanium). Venus may contain valuable resources as well, but no real research has been done there. The four other planets, Jupiter, Saturn, Uranus and Neptune are especially interesting because of the presence of He-3 and Hydrogen. The latter could be of great use as an alternative fuel source for transportation means. Except for Venus and Mercury, all other planets have natural satellites. Natural satellites are basically moons circulating a planet. These could also be commercially interesting for several of their characteristics, some most likely the same as the Moon of the earth. Furthermore some moons are even likely to contain water and ice, which could be in the future of great commercial use. The big issue with the planets and their moons is the fact that they are incredibly hard to reach. Where an exploitation mission to the Moon is already costly, difficult and on the verge of being possible, space missions beyond the Moon are not very likely in the near future. Although the manned exploration to Mars is the next probable goal in space exploration in the next decades38, this is only remotely possible because of the similar environment with the earth. Exploitation and even exploration of other planets will be a matter situated in an even
further future.

7. Asteroids and Comets

The big space event in 2014 was the landing of the spacecraft Philae on the comet Rosetta.The objective was not fully realized; Philae landed not on the foreseen area. However, it was seen as a huge success. Whereas the purpose of the mission was solely scientific, it has a great importance for extraterrestrial exploitation as the step towards exploiting a celestial body such as an asteroid or a comet was partly manifested by the landing of a spacecraft on it. Mining asteroids is however, a more popular idea than mining comets. This results from differences between both, which makes the mining of asteroids more probable and much easier. Most comets reside in the farther reaches of our solar system and have extended and elongated orbits compared to the short

circular orbits of asteroids. Adding to this that there are NEAs (near earth asteroids) also contributes to the fact that mining asteroids is easier because of their proximity. There is a whole taxonomy for asteroids, which demonstrates their plurality with different kinds and different features. For NEAs, it is know that many of them are rich in metallic compounds and water. These resources could be used for sustaining satellites in space or for life on earth. Comets also contain valuable resources such as methane ice, ammonia, and water ice. These could as well be of commercial value. As mentioned before, however, the characteristics of a comet, makes it a more difficult target for exploitation.

8. Relevant Legal Instruments

There are few important international instruments to look at concerning the exploitation of celestial bodies. The first legal instrument that will follow is a look at 'The Declaration of Legal Principles Governing the Activities of States in the Exploration and Uses of Outer Space' of 1967, known as the Outer Space Treaty. This treaty forms the basis for international space law. It can be seen as the Magna Carta of space law. Besides the Outer Space Treaty there is the 'The Agreement Governing the Activities of States on the Moon and Other Celestial Bodies' of 1979, known as the Moon Agreement. This treaty is generally perceived as an international failure whereas the space-faring states have not signed it. The reason of failure can mainly be addressed to the presence of the principle of the Common Heritage of Mankind in the treaty, which determines certain conditions for exploitation. Nevertheless, it is an important document to analyze due to several reasons i.e. it is the only international treaty where space exploitation is explicitly handled and the Moon Agreement is a valid treaty entered into force where the parties have to respect its provisions. Reasons exist to believe that the Moon Agreement can still have a role in handling exploitation rights. Next to those two treaties, an analysis will follow of one of the five principles of UNOOSA i.e. 'The Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries', known as the Declaration on Space Benefits. With this principle, the Outer Space Treaty is made slightly more understandable in light of exploitation rights. It is important to note that this principle is soft law and not a treaty. This means that it is not legally binding. However, soft law has a strong political value in the international community, as will be discussed.

Conclusion

In the continuation for first United Nations space policy conference in Moscow. It is now clear that there are a lot of extraterrestrial resources, which have great commercial potential. However, the technology at hand still is in its infancy, which hints at the fact that mining the Moon or asteroids will not be a matter for this decade. However, technological advancements and preparations point to the fact that it might become reality in the following decades. Governments and companies take actions in order to prepare themselves to start mining the solar system, two major companies already specialize in mining asteroids and are doing tests and experiments. The landing of Philae is a first concrete prove that shows the tangibility of putting a robotic machine on a comet and space-faring nations like Russia and China are preparing themselves to go (back) in space and look for the riches of the Moon. These evolutions demonstrate that the willingness of making the jump into space is present and with the help of private industry, governments can really get involved again. Yet, the lack of an international regime for mining extraterrestrial resources can create problems. On one hand, it could slow down activities and thus discouraging innovation in space technology. Looking at the current evolutions in the space sector, this is currently not the case. On the other hand, it could create an uncontrolled environment for space activities, which

would be worse. The unique ecosystem of space could be in danger of getting harmed and there could be a case of neo-colonization, where only space-faring nations would enjoy the fruits of outer space. This should be avoided by the creation of an international controlled, commercial environment for space activities. We need create the consortium among the government and private space agencies for Common Platform of Space policy and legalization for peaceful and commercial access.

References:

1. Agreement governing the Activities of States on the Moon and Other Celestial Bodies, UNTS
2. Vol. 1363, entered into force on 11 July 1984 (The Moon Agreement).
3. Agreement relating to the Implementation of Part XI of the United Nations Convention on the
4. Law of the Sea of 10 December 1982, UNTS Vol. 1836, entered into force on 1 April 1998 (Implementation Agreement of 1994).
5. The Antarctic Treaty, UNTS Vol. 402, entered into force on 23 June 1961.
6. The Convention on International Liability for Damage Caused by Space Objects, UNTS Vol. 961, entered into force in September 1972.
7. Convention on the High Seas, UNTS Vol. 450, entered into force on 30 September 1962.
8. Convention on the Regulation of Antarctic Mineral Resource Activities, (CRAMRA), http://www.state.gov/documents/organization/15282.pdf.
9. Constitution of the International Telecommunication Union, Vol. UNTS 2134, entered into force on 1 July 1994 (ITU Constitution).
10. The Protocol on Environmental Protection to the Antarctic Treaty, entered into force in 1998, http://www.ats.aq/documents/recatt/Att006_e.pdf.
11. Statute of the International Court of Justice, Vol. UNTS 2187, entered into force on 1 July 2002 (ICJ Staute).
12. Treaty on principles governing the activities of States in the exploration and use of outer space, including the moon and other celestial bodies, UNTS Vol. 610, entered into force on 10 October 1967 (The Outer Space Treaty).
13. United Nations Convention on the Law of the Sea, UNTS Vol. 1833; 1834; 1835, entered into force on 16 November 1994 (UNCLOS III).Vienna Convention on the Law of the Treaties, UNTS Vol. 1155, entered into force on 27 January 1980.
14. Pieter De Cnudde, Mining The Moon: Current And Future Exploitation Regime (2015)