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South Africa's Space Odyssey: To the Moon and Beyond

An analysis of how the development of space legislation and policies may propel South Africa as a spacefaring nation whilst solving basic socio-economic problems

BY

Phindulo Maureen Mamafha

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Prof. Dr Stephan Hobe

SUMMARY

The concept of outer space exploration has always been perceived as an abstract idea explored through sci-fi movies and comics. Over the years, this abstract idea seems to have developed into reality. With the emergence of new research by the National Aeronautics and Space Administration (NASA) and the recent technological advancement by aerospace companies such as SpaceX, Blue Origin, and Virgin Galactic, not only has outer space exploration become topical, but it has also sparked different views within the legal fraternity.

Since the first Outer Space Treaty was signed in 1967, outer space research has advanced tremendously through outer space exploration. As worldwide research uncovers the benefits of outer space exploration and technology, it is imperative that the regulations of the outer space exploration industry be updated to regulate these new possibilities.

As the spacefaring nations develop their policies to allow for current and future possibilities such as asteroid mining, it may seem as though African states such as South Africa have been left behind. Not only has the involvement of African states in outer space exploration become critical to fostering economic development, but it has also presented the opportunity for African states to contribute strategically to global legal and economic debates. This begs the question of the involvement of African states in space exploration activities, particularly South Africa, which is one of the leading economies on the continent.

What legislation is South Africa developing to gain investor security and to encourage space exploration activities? What can South Africa learn from other countries that have been leading research in the aerospace industry, such as the USA, Russia and China? What value can be extracted from the collaboration of African countries through the African Union? Lastly, what socio-economic issues may be solved by space exploration and the possibility of space mining? With these key questions in mind, this study seeks to investigate the development of policies by South Africa that conform to international law. It investigates how South Africa may improve its policies to take full advantage of the freedoms granted in Article I of the Outer Space Treaty, and the socio-economic issues that may be solved by space exploration and the possibility of space mining.

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Biographical information of student	
Student #	16051310
Title	Ms
Surname	Mamafha
Initial(s)	Phindulo Maureen
Registered for the: LLM / MPhil (coursework) ◉ : or LLM / MPhil ○ : or LLD / PhD ○	Email u16051310@tuks.co.za / maureenpeendu78@gmail.com
Mobile phone #	0760359186

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Chapter 1

Introduction

1.1 Main research problem

This study explores the development of space law in the context of freedoms granted to states in terms of Article I of the Outer Space Treaty. It investigates the current position of South African space policies and enquires how such policies can be developed further to enhance South Africa's participation in the emerging space industry. The main question that this study seeks to answer is: How can South Africa improve its contribution to the outer space industry and address its socio-economic problems by developing laws and regulations related to outer space?

This question is answered by, firstly, providing a brief overview of international outer space law and investigating the historical background of Article I of the Outer Space Treaty. Secondly, the study investigates how South Africa has adopted and applied international outer space law principles to domestic legislation, allowing for the possibility for the country to achieve its goals. Thirdly, it investigates lessons that South Africa may learn from other spacefaring nations and the benefits of collaboration between African states through the African Union. Fourthly, the economic benefits of the development of outer space legislation are investigated, taking into consideration the unique economies of most African states. Lastly, concluding remarks and suggestions for possible future solutions are provided.

1.2 Background

The African continent comprises 54 states, more than 1 500 languages, a population of more than 1.2 billion and an economy that is largely underdeveloped.[1] Challenges such as food insecurity, lack of environmental sustainability plans, lack of access to equal opportunities, lack of access to electricity, and poor infrastructure development interfere with the economic development of most African states.[2]

The emergence of satellites has changed how people interact with each other and the Earth. In May 2014, it was reported that the Nigerian government with the assistance of the United States of America (USA) government used two satellites to help follow the activities of the terrorist group, Boko Haram, to locate more than 300 schoolgirls who had been kidnapped by the group.[3] Through the SAT4Farming programme,

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1 Deborah Smith, Johnston Barbara Brown 'Curriculum Guide: "How Big is Africa?" (Pardee School of Global Studies, African Studies Center 2021) <https://www.bu.edu/africa/outreach/teachingresources/geography/curriculum/curriculum-guide/ > accessed 09 March 2021.

2 Tarik Oguz, "What are the top 5 challenges Africa is facing?" (Trilac 2017) <https://www.tralac.org/discussions/article/11690-why-is-25th-may-important-for-african-nations.html > accessed 12 April 2021.

3 Pranay Varada 'The Space Race Expands: Why African Nations Are Looking Beyond Earth' (Harvard International Review 2022) < https://hir.harvard.edu/why-african-nations-are-shooting-for-the-stars/ > accessed 24 August 2023| Craig Whitlock 'Pentagon setting up drone base in Africa to track Boko Haram fighters' (The Washington Post 2015) <

Ghana is able to assist small-scale farmers with planning for changing climate conditions through satellite imagery.[4] In South Africa, Astrofica as a start-up company is expanding the satellite data collection programmes with a view to eliminating reliance on international providers.[5]

The concept of outer space exploration has always been perceived as a fictional idea. Over the years, this "fictional idea" seems to have developed into reality. With the emergence of new research by the National Aeronautics and Space Administration (NASA), and the recent space launches by SpaceX, Blue Origin and other space exploration companies, the possibility of life outside Earth seems to be taking shape, and sourcing minerals from space seems possible. Space research has made huge strides since the first space treaty came into effect in 1967.[6]

As global space research is discovering benefits of outer space exploration, such as those mentioned above, it may seem as though African states have been left behind by the broader legal, scientific, and economic debates. While many would contend that African states, which are classified as developing or third-world countries, should instead concentrate on ensuring the provision of basic necessities, and eliminating socio-economic problems that may be more urgent and pressing. It is crucial to note that African states' investments in space exploration could lead to better strategic outcomes, eradicate socio-economic problems permanently, and establish African nations as stronger rivals that produce and export goods rather than being mere consumers.

For purposes of this study, there are specific concepts that must be defined before investigating the development of outer space law.

Outer space law can be defined as regulations, treaties, agreements, and conventions created to enable, manage, and regulate worldwide, regional, and national commercial, civil governmental, and national or regional defence activities in or related to outer space.[7] From this definition, it can be said that space law has two different spheres in which it operates.[8] One is international law that regulates the rights and obligations of states, and the other is national law whereby each state regulates the activities that take place within its territory.[9] There is no strict definition of what space law is, and international space legislation does not define outer space. However, there seems to be consensus that outer space is an area that starts

https://www.washingtonpost.com/world/national-security/pentagon-setting-up-drone-base-in-africa-to-track-boko-haram-fighters/2015/10/14/0cbfac94-7299-11e5-8d93-0af317ed58c9_story.html > Accessed 24 August 2023.

4 Varada 'The Space Race Expands: Why African Nations Are Looking Beyond Earth' (n 3).

5 *Ibid*.

6 Alex Gilbert. "Mining in Space Is Coming" (Milken Institute Review 2021) <https://www.milkenreview.org/articles/mining-in-space-is-coming> accessed 13 June 2021.

7 Nandasiri Jasentuliyana Keynote Address on Space Law: A concise history of space law, IISL (01 March 2021) < www.stephenedoyle.com> 15 September 2021.

8 Ma Xinmin, 'The Development of Space Law: Framework, Objectives and Orientations' (speech at United Nations/China/APSCO Workshop on Space Law, Deputy Director-General, Department of Treaty and Law, Ministry of Foreign Affairs, The People's Republic of China, Beijing, November 17, 2019) Accessed 01 February 2021.

9 *Ibid*.

between 80 km and 100 km above sea level, which is referred to as the "Van Karman line" as there is no airspace in this area.[10] Ferreira-Snyman refers to "outer space" as the entire universe, any area beyond the atmosphere of the earth, and from a legal perspective it is the area within the universe where humans can reach and participate in human activities.[11]

Asteroids can be described as smaller planets that cannot be said to have shape or form, and they rotate in different ways around the sun.[12] Most asteroids are found in the belt between Jupiter and Mars.

A **space object** does not have a complete definition; however, it is described as any object that travels to, in or through outer space without the use of air after it has been launched into orbit from either Earth, Moon or any other celestial body.[13] This concept is important to define because it allows for issues of liability, jurisdiction and control to be determined.[14]

Asteroid mining is defined as the hypothetical exploitation of materials from asteroids and other minor planets, including near-Earth objects.[15]

1.3 Methodology

The research methodology followed in this study is of a literary nature. Information from books and journals, case law, internet sources and legislation are used to investigate and compare similarities and differences between the applications of outer space law, internationally and domestically.

1.4 Structure overview

Chapter 1 introduces the topic of the study by outlining the main research question and by providing a general overview of the key concepts investigated in this study. Chapter 2 traces the historical background of international outer space law, particularly Article I of the Outer Space Treaty.[16] Chapter 3 introduces an investigation into the spacefaring nations and possible collaboration with other African states. This chapter seeks to investigate the different relationships that South Africa may leverage in its quest to be a spacefaring nation on the African continent and outside, through its different strategic relationships. Chapter

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10 Sanz Fernández de Córdoba '100 KM altitude boundary for astronauts' (FAI Astronautic Records Commission 2020) <https://www.fai.org/page/icare-boundary> accessed 4 May 2021.

11 Anél Ferreira-Snyman 'Legal challenges relating to the commercial use of outer space, with specific reference to space tourism' (Potchefstroom Electronic Law Journal 2014) https://scielo.org.za/pdf/pelj/v17n1/02.pdf accessed 4 May 2021.

12 National Aeronautics and Space Administration 'Asteroids' (National Aeronautics and Space Administration 2021) < Asteroids – NASA Science> accessed 26 July 2021.

13 Louis de Gouyon Matignon, 'The definition of space object, Space Legal Issues' (Space Legal Issues 2019) <https://www.spacelegalissues.com/space-law-the-definition-of-a-space-object/> accessed 08 August 2021.

14 Xinim, The Development of Space Law: Framework, Objectives and Orientations, (n 8).

15 Atossa Araxia Abrahamian, 'How the asteroid-mining bubble burst' (Technology Review 2021) < https://www.technologyreview.com/2019/06/26/134510/asteroid-mining-bubble-burst-history/> accessed 08 August 2021.

16 The first layer of the dual spheres of space law, which is international law, is discussed, followed by a brief discussion of Article I of the Outer Space Treaty.

4 explores the socio-economic impact of the development of outer space law in South Africa and how South Africa may leverage its existing resources to compete on the same level as spacefaring nations. Chapter 5 concludes the study by reflecting on the main arguments and findings of the study, and by proffering some recommendations.

Chapter 2

Historical Background

2.1 Introduction

Lawyers such as Emile Laude, Vladimir Mandl, Vladimir Kopal, Manfred Lachs, and V.A. Zarzar were of the view that outer space exploration would become a common concept.[17] They suggested that there had to be development of outer space law to allow for outer space exploration and regulation of new technologies.[18] Their research made it possible for the then spacefaring states like the USA and the Union of Soviet Socialist Republics (USSR) to comprehend the necessity of creating outer space governance. This led to the formulation of United Nations declarations and five of the most important treaties related to outer space law in the 21st century.[19]

As the world grapples to understand the different concepts within outer space technology, many questions arise with regard to the current legal framework and the legality of the many space activities. This chapter aims to investigate such legal framework and the status thereof. This will be achieved by tracing the historical background of international outer space law. Article I of the Outer Space Treaty is discussed as an introduction to the freedoms granted by the Outer Space Treaty.

2.2 The Development of International Space Law

The historical background of the outer space industry should not only be investigated through legislative lenses.[20] A view of the technological development that occurred around the period in which the legislation was developed should be investigated and examined to provide background for the ongoing space exploration initiatives, and to provide a clearer, more comprehensive knowledge of the evolution of space legislation.[21] This section aims to provide a historical background of the development of space law and a brief view of the technological developments to gain a clearer understanding of the study to follow.

After the first artificial satellite was launched in 1957, the treaty framework started developing.[22] At this point, space activities were only executed by states without the assistance of private entities.[23] The treaty framework is the foundation that guided lawmakers in the development of their domestic laws. This was to

17 Xinim, The Development of Space Law: Framework, Objectives and Orientations, (n 8).

18 *Ibid*.

19 *Ibid*.

20 Stephan Hobe et al, Cologne commentary on Space Law Vol. 1, Outer space treaty Volume 1 (2nd edition, BWV Berliner Wissenschafts-Verlag, Berlin 2017) 2.

21 Stephen Hobe et al, Cologne commentary on Space Law Vol. 1, Outer space treaty Volume 1, (n 20).

22 *Ibid*.

23 *Ibid*.

ensure a common understanding of what was permissible within space activities. The historical developments are traced as follows:

The period between 1957 and 1963 entailed the resolution phase after the first artificial satellite was launched.[24] Most of these discussions were between the Soviet Union and the United States, who were pioneering space exploration at the time.[25] These discussions involved looking at whether space exploration could be regulated just as air law as prescribed by the regulations of the early 20th century, or as a separate law of its own.[26] In these discussions, the idea that space activities should be done for the greater good of humanity seemed to be the common ground that most states shared.[27] This common ground led to the principle that outer space could not be owned by any state or by any private person or organisation.[28] During this phase, the international community wanted to have the certainty that activities in space would not be harmful to humanity.[29]

The United Nations (UN) assumed the responsibility of developing a legal framework for the regulation of how states should interact with outer space. The UN General Assembly was expanded with committees to assist with the mandate of developing this legal framework.[30] The United Nations Committee on Peaceful Uses of Outer Space (COPUOS) was tasked with developing principles that would guide the interaction of member states with outer space.[31] The Scientific, Technical and Legal (STL) sub-committees were formed under the Office of Outer Space Affairs (OOSA) which was under the COPUOS.[32] These subcommittees were to assist in the execution of the mandate that was given to the UN.[33] Through these offices, COPUOS has established many principles that serve as a foundation for space exploration today.[34] The principle that prohibits military use of outer space, and the principle that provides for celestial bodies, are not for states' appropriation, amongst other fundamental principles.

The period between 1963 and 1979 was the Resolution to Treaty phase.[35] This phase was the ground-making phase for the regulation of international space activities. This period resulted in the five outer space

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24 Office for Outer Space Affairs United Nations Office at 'Vienna Disseminating and developing international and national space law: The American and Caribbean perspective.'| Hobe 'Current and Future Development of International Space Law' ST/SPACE/28 3.

25 Bradley Shreve, 'The US, The USSR, and Space Exploration 1957-1963' [2003] *IJWP* 20, 67.

26 Hobe, Current and Future Development of International Space Law' (n 24).

27 Shreve, The US, The USSR, and Space Exploration' (n 25).

28 Anel Ferreira-Snyman and Ferreira Gerrit, 'The Application of International Human Rights Instruments in Outer Space Settlements: Today's Science Fiction, Tomorrow's Reality' [2019] PER / PELJ 1, 1.

29 *Ibid.*

30 Annette Froehlich, 'Space Resource Utilization: A View from an Emerging Space Faring Nation', (1st ed, Springer International Publishing, AG 2018) 3.

31 Delgado López et al., 'The Importance of the United Nations Guidelines for the Long-Term Sustainability of Space Activities and Other International Initiatives to Promote Space Sustainability' (2014) *Oasis* 20, 37.

32 *Ibid.*

33 *Ibid.*

34 *Ibid.*

35 Hobe, 'Current and Future Development of International Space Law' (n 24).

treaties that are key to regulating space activity.[36] They are the Outer Space Treaty, the Rescue Agreement, the Liability Convention, the Registration Convention, and the Moon Agreement. While this study focuses particularly on the Outer Space Treaty, with specific attention to Article I,[37]other treaties will be summarily discussed to the extent in which they are applicable to this study.

The Outer Space Treaty was concluded as a product of the resolution that already existed in 1963.[38] The Outer Space Treaty currently has 114 states-parties out of 193 states, which is more than 50% of states.[39] This is a good representation of states in space exploration. This treaty contains general principles that are found in different space law instruments. Some of these principles are as follows:

1. *the non-appropriation principle;*
2. *the principle for exploration and the conditions for the various uses of outer space;*
3. *the principle for registration and of liability for governmental and non-governmental space activities; and*
4. *the rescue and cooperation principle as well as some ideas on the protection of the outer space environment.* [40]

It is interesting to note that the general theme of the Outer Space Treaty is responsible use and exploration of space, including the protection of outer space against ownership.

The Outer Space Treaty has the most ratifications by states in space law.[41] It is therefore the most important instrument in international space law, both as a basis of current developments, and as a futuristic document that serves as a base for future developments within space law. As the Outer Space Treaty is not an instrument of human rights, it cannot be referred to as the Magna Carta. However, the weight of influence that the Outer Space Treaty carries can be compared to that of the Magna Carta in human rights law. The Outer Space Treaty has gained the legal status of international customary law. Many principles and declarations have thus been informed by the general principles in this instrument. South Africa signed the Outer Space Treaty in March 1967 and has also ratified the treaty.

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36 Ian Christensen et al., 'New Policies Needed to Advance Space Mining' [2019] ISTNASE 26, 26.

37 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Moon and Other Celestial Bodies. United Nations, 19 January 1967 (adopted by the General Assembly in its resolution, "Outer Space Agreement"); Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space. United Nations, 19 December 1967 (adopted by the General Assembly in its resolution "Rescue Agreement"); Convention on International Liability for Damage Caused by Space Objects. United Nations, 1 September 1972 (adopted by the General Assembly in its resolution "Liability Convention"); Convention on Registration of Objects Launched into Outer Space United Nations. 12 November 1974 (adopted by the General Assembly in its resolution "Registration Convention"); Agreement Governing the Activities of States on the Moon and Other Celestial Bodies, United Nations, 5 December 1979 (adopted by the General Assembly in its resolution 34/68) The "Moon Agreement").

38 Hobe, 'Current and Future Development of International Space Law' (n 24).

39 *Ibid.*

40 *Ibid.*

41 Xinim, The Development of Space Law: Framework, Objectives and Orientations, (n 8).

The Rescue Agreement was adopted in 1968.[42] This agreement covered the rescuing of astronauts, and the return of astronauts and objects from space. Therefore, the aim of the agreement is to lay down principles that protect astronauts.[43] This treaty currently has 98 ratifications. In 1972 the Liability Convention was adopted; this adoption was seen as notable progress because it developed international liability against perpetrators who cause damage through space objects. Currently it has been ratified by 96 states.[44] In 1975, the Registration Convention was opened to signatures from states and has been ratified by 69 states to date.[45] The final treaty development was in 1979. It was termed the Moon Agreement, which was adopted by the UN and currently has 18 ratifications. The Moon Agreement could have been the most appropriate treaty to discuss in relation to space mining for the scope of this study; however, due to the lack of endorsement by states, this treaty has been considered by most as a failed treaty.[46]

It is worth noting that in the history of the development of outer space law, international treaties and customs have been the primary sources of legally binding international law. There are five principles that govern outer space law, namely:

- Declaration of Legal Principles of 1963;
- Principles Governing Television Broadcasting of 1982;
- Remote Sensing of 1986;
- Nuclear Power Sources of 1992; and
- International Cooperation in Outer Space of 1996.

These principles can be read with the UNGA resolutions as well as the UN COPUOS documents, which serve a subsidiary function.

In recent years, scholars have noted that international outer space law has taken the direction of soft law. Soft law may be described as regulations that are intended to drive behaviour and action of states by issuing prescriptions and guidance that do not have severe consequences where they are not implemented.[47] Although soft law is not noted as one of the traditional sources of foreign public law, as stated in ICJ Statute Art 38, it may be noted that such omission may be viewed as intended to ensure that soft law retains its status as non-binding.[48]

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42 Annette Froehlich, 'Analysis of the Current International and National Governance Framework as Pertaining to Resource Extraction and Utilisation in Space' (1st edn, Springer, Cham 2018), 13.

43 The Rescue Agreement.

44 Froehlich, Analysis of the Current International and National Governance Framework as Pertaining to Resource Extraction and Utilisation in Space (n 42), 13.

45 *Ibid.*

46 Ibid 13| Sarah Coffey, 'Establishing a Legal Framework for Property Rights to Natural Resources in Outer Space, Case', (2009) WRJIL 119, 199. | The Moon Agreement. It is important to note that the power states in space exploration such as the United States, China, Japan, Russia and India are not party to the treaty. It currently only has seven ratifications.

47 Arya Gerda Haager, 'The importance of non-binding instruments in international space law' (Austria in space 2022), 1.

48 Hobe, Current and Future Development of International Space Law' (n 24).

Outer space technology is developing rapidly. Consequently, rapid development of legislation is required to allow for effective regulation of such technological advances. If this is not done, it could mean that by the time the treaties are developed, the law may be outdated and not relate to current challenges, and therefore not provide for effective regulation. The strength of soft law lies in its ability to enlarge or add to the fundamental theories of existing treaties and other hard law, without the extended time-consuming efforts that may be present when developing many forms of hard law.[49] As an advantage, soft law is viewed as much easier to negotiate by states, and may establish the minimum standards issued by industry experts that may be followed to ensure the sustainability of outer space law.[50]

Guidelines such as the "Guidelines for the Safe Use of Nuclear Power Sources" and the "Guideline for the Mitigation of Space Debris" are great examples of soft law documents.[51] These documents do not necessarily present any views on the much-debated issues of outer space exploration, such as political or economic issues, but mainly focus on technological guidance, providing guidelines that might assist from a safety perspective.[52] Even though the guidelines provided in these documents act as a supplement to legislation that already exists, they focus on practical areas that might be of considerable use to states that would like to stay within the confinement of the Outer Space Treaty, whilst remaining safe and secure.[53]

Many scholars in the outer space industry have been calling on spacefaring states to engage in discussion through COPUOS to develop further non-binding legal principles that may clear up many widely debated concepts such as property rights, space resource extraction and risk mitigation.[54] This is an example of an opportunity that presents itself in the hands of developing states like South Africa. Although South Africa could not participate meaningfully in the initial "space race" with not much influence in the early treaty framework, there is an opportunity in this instance to engage in these discussions to ensure that not only interests are protected in the soft law policy discussions, but to learn from and engage with other spacefaring states in what can be developed domestically to provide for asteroid mining and other space activities.

49 Laura Byrd, 'Soft Law in Space: A Legal Framework for Extraterrestrial Mining', [2022], ELJ 801, 831.

50 Laura Byrd, 'Soft Law in Space: A Legal Framework for Extraterrestrial Mining', (n 48).

51 *Ibid.*

52 Francis Lyall et al., Space Law: A Treatise*, (*1st edition, Ashgate Publishing Limited, United Kingdom 2013), 52.

53 Francis Lyall, Space Law: A Treatise, (n 51).

54 Laura Byrd, 'Soft Law in Space: A Legal Framework for Extraterrestrial Mining', (n 48).

2.3 Article I of the Outer Space Treaty

Article I (1) of the Outer Space Treaty in essence states that the use and exploration of outer space should be done for the unified interest of all states.[55] It introduces the concept of "the province of humankind" and specifically mentions that the degree of economic or scientific development of a state should not hinder a state from participating in space-related activities. There are many debates on the term "province of humankind" and what this actually means. Other writers have observed and noted that the term is not referenced in the world's leading encyclopaedias. The USA Senate Foreign Relations Committee has defined the term to mean the same as "benefit of all mankind".[56] A comparison is also drawn between the meaning of the "province of humankind" concept and the "common interest" principle, and whether they are connected.[57]

The generally accepted distinction between the common interest principle and the province of humankind concept may be summarised by stating that the common interest principle refers more to the ownership of international zones, whilst the province of humankind concept refers to equal applicability of international law to all states.[58] The common interest principle is further open to debates between developed and developing states. Developing states are aligning themselves to the definition of common interest, which implies that a state that has not participated financially or otherwise would share in the benefit of the activities conducted in the shared international zone.[59]

Developed states, on the other hand, are refuting this as it seems to be unfair to the states that have invested time, finances and resources in exploring outer space. Developing states would be more inclined to define the common interest principle as implying that the shared international zones are free to be exploited by anyone in any way they see fit. [60]This way, developing states may still gain their economic benefit whilst also sharing the zone.[61] This is more inclined to the province of humankind principle. The principle of the province of humankind seems to be aligned with territory, which gives effect to control rather than property. This principle speaks to the fact that there is no one nation that owns outer space, and therefore no one state can exercise its own state rules. [62] Between the two ideas, it is evident that while states are free to explore outer space, they are not vested with any authority over the Moon or any other celestial bodies.[64] The main point is that states are free to conduct space activities as long as they benefit

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55 Article I (1) of the Outer Space Treaty.

56 Isabella Henrietta Philepina Diederiks-Verschoor and Vladimír Kopal, *An introduction to space law*, (3rd edn, Kluwer Law International, 2008), 25.

57 Carol Buxton, 'Property in Outer Space: The Common Heritage of Mankind Principle vs. the First in Time, First in Right, Rule of Property', [2004], JALC 689, 691 – 692.

58 Article 1(1) of the Outer Space Treaty.

59 Buxton Property in Outer Space: The Common Heritage of Mankind Principle vs. the First in Time, First in Right, Rule of Property', (n 57), 692 – 693.

60 *Ibid.*

61 *Ibid.*

62 *Ibid.*

all of humanity, despite many disagreements about the precise meaning of the limitation and how it has evolved over time.

Article I (2) of the treaty provides freedom of exploration, granting all states the freedom to use and explore outer space without any discrimination.[63] It states that the Moon and other celestial bodies are free for exploration by all states.[64] This qualifies the freedom principle as it gives freedom to all states to explore outer space. This means that space activities should benefit any nation, regardless of its socio-economic status, geographic location, level of military might, or level of scientific advancement. [65] This freedom is not only granted to states but includes both private entities and intergovernmental organisations that operate within states.[66]

States have access to freely explore outer space without any form of discrimination, based on the principle of equality provided for by international law.[67] This principle should be read together with Article II(1) of the UN Charter, as the term equality used in the context of this article is an affirmation of equal rights of all states to explore outer space. This provision addresses specifically developing states like South Africa, which may not have the largest resources, infrastructure, or technology, but through this provision they too have a right to profit from any space activities that are undertaken worldwide.

The right to freely explore outer space is, however, limited to abuse and misuse of rights. Therefore, states are responsible not only for their actions that may be unlawful, but also those that cause harm to other states.[68]

2.4 Conclusion

The development of outer space law has come a long way over the years, from an era when there was no legislation to regulate outer space activities, to an era where there is a treaty that is signed by most states in the world. Soft law has presented itself as an opportunity for South Africa to get practically involved in the discussions and to make sure its views and guides are noted through soft laws or through commentary of other soft law guidelines that have been presented. Article I of the Outer Space Treaty grants freedom to all states without discrimination to explore the outer space and introduces the province of humankind principles. This article also presents a clear opportunity for South Africa to participate fully in the industry and to be leveraged by the research of other states that have a well-developed industry.

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63 Article I (2) of the Outer Space Treaty.

64 Article 1(2) of the Outer Space Treaty.

65 Stephan Hobe et al., *Cologne Commentary on Space Law Vol. 1, Outer Space Treaty* Volume 1, (n 19).

66 Stephan Hobe and Steven Freeland, 'The Fundamental Principles of Space Law and the Relevance of International Law', [2013] Institute of Air and Space Law, Cologne University, Cologne, Germany 29.

67 *Ibid.*

68 Ferreira-Snyman A and Ferreira G, 'The Application of International Human Rights Instruments in Outer Space Settlements: Today's Science Fiction' (n 28).

Chapter 3

Development of Space Legislation in South Africa – Lessons that may be Learned from Spacefaring Nations and other African States

3.1 Introduction

Article I of the Outer Space Treaty grants states the freedom to explore outer space. This freedom is not only granted to states that are regarded as "powerful states", but it is also granted to developing states such as South Africa. From this freedom emerges the responsibility for states to formulate legislation that will regulate the use of outer space that is in line with the principles of international law.[69]

This chapter will investigate how South Africa may use current legislation to propel the country to new heights in terms of the freedom granted in Article I of the Outer Space Treaty. It investigates lessons from spacefaring nations such as the USA, which is leading the industry in terms of private sector contributions to outer space exploration. Russia and China, who are excelling in contributing to the growth of African states whilst internationalising their outer space policies and programmes, are also investigated. Lastly, collaboration between African states through the African Union may lead to an African space force to be reckoned with.

3.2 The development of outer space legislation in South Africa

In March 1967, South Africa signed the Outer Space Treaty and in the following year the treaty was ratified.[70] The South African military programme began in the 1980s and it took about 13 years for the first significant piece of legislation to be enacted, which is the Non-Proliferation of Weapons of Mass Destruction Act 84 of 1993.[71] The purpose of this legislation was to control the use of weapons of mass destruction in combat.[72] The South African Council of Space Affairs was established by the Space Affairs Act 84 of 1993, which was amended in 1995.[73] Its purpose is to oversee and manage certain space affairs within the Republic and to provide guidelines for the appointment of a vice-chairperson to the South African Council for Space Affairs.[74] This Act, which strategically directs and governs all space activities in the nation, is the

69 Article 6 of the Outer Space Treaty.

70 U.S. Department of State 'Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies' < https://2009-2017.state.gov/t/isn/5181.htm > accessed 4 October 2023.

71 Non-Proliferation of Weapons of Mass Destruction Act 84 of 1993.

72 *Ibid.*

73 Space Affairs Act 84 of 1993, which was amended in 1995.

74 *Ibid.*

cornerstone of South African outer space law. As a result, this Act's provisions apply to both the National Space Programme and any space-related activities carried out by government or commercial organisations.[75]

The first South African satellite was launched in February 1999. It was manufactured by a group of postgraduate students from the University of Stellenbosch.[76] This satellite was called the Stellenbosch University Satellite (SUNSAT), and was the first small satellite produced in South Africa.[77] The mid-2000s saw a range of developments which were key in the development of the South African astronomy industry. The Sumbandila (Pathfinder) satellite programme was the first of its kind and was designed to support the country's space programme. This satellite was launched in 2005 but was later discontinued due to a crash that rendered it unusable.[78] The largest optical telescope in the southern hemisphere, the South African Large Telescope (SALT), was opened in 2005 and placed South Africa on the world map. It enables spectroscopic and polarimetric analysis as well as imaging of the radiation from astronomical objects that are beyond the reach of telescopes in the Northern Cape.[79] As a build-up to the Square Kilometre Array (SKA) in the Northern Cape province, South Africa invested in the construction of the Karoo Array Telescope (MeerKAT) in 2003.[80] This telescope was constructed by a group of approximately 100 organisations in roughly 21 countries. The SKA is the largest radio telescope in the world.[81]

In early 2007, the South African Cabinet ordered the Department of Science and Technology (DST) to start planning the creation of a space agency in South Africa. The DST started by creating a national space science and technology strategy to direct the execution of the upcoming space programme, in addition to starting work on the drafting of the legislation required to create the space agency.[82] Within the framework of the national government, the South African National Space Agency Act 36 of 2008 promotes the use of outer space and cooperation in space-related activities.[83] It supports the development of scientific engineering through human capital, and fosters research in space science. It also supports the creation of an environment that is favourable to the industrial development of space technologies.[84]

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75 Department of trade and Industry South Africa 'National Space Policy page' (2008) 6.

76 Dragonfly Aerospace 'Inside Sunsat – Africa's first-ever domestically developed satellite', (Dragonfly Aerospace 2021), < https://dragonflyaerospace.com/inside-sunsat-the-first-ever-south-african-satellite/ > accessed 19 February 2023.

77 Dragonfly Aerospace 'Inside Sunsat – Africa's first-ever domestically developed satellite' (n 76).

78 South African National Space Agency 'SumbandilaSat reaches the end of its life" (South African National Space Agency 2021) < https://www.sansa.org.za/2021/12/10/sumbandilasat-reaches-the-end-of-its-life/> accessed 20 February 2023.

79 South African Astronomical Observatory 'South African Large Telescope' < https://www.saao.ac.za/explore/our-telescopes/salt/ > accessed 21 February 2023.

80 South African Radio Astronomy Observatory 'The project', (South African Astronomy Observatory 2022), < https://www.sarao.ac.za/about/the-project/ > accessed 21 February 2023.

81 *Ibid.*

82 Department of trade and Industry South Africa 'National Space Policy page' (n 75) 13.

83 South African National Space Agency Act 36 of 2008.

84 *Ibid.*

A more proficient act that allows for the implementation of space policies that further regulate space activities is the South African National Space Agency Act. This act founded the South African National Space Agency (SANSA) and its operations. SANSA is the backbone of the current South African space industry, carrying out policy through advancements in research and development. The act places a strong emphasis on the growth of South Africa's space industry to promote continued technological advancement and ensure its independence. In compliance with the Outer Space Treaty, to which South Africa is a party, South Africa commits in this act to using space for the benefit of humanity.[85]

The Independent Communications Authority of South Africa (ICASA) is constituted under the Independent Communications Authority Act 13 of 2000, as amended.[86] The Astronomy Geographic Advantage Act 21 of 2007 is a piece of legislation that grants the Minister of Science and Technology the authority to designate regions as strategically important to the country's astronomy and related scientific endeavours through regulatory measures.[87]

The National Space Policy of South Africa offers broad guidelines for the development of suitable space capabilities and the use of space system applications to support economic growth, eradication of poverty, and advancement of knowledge.[88] Additionally, in order to better inform South Africa's participation in both domestic and international space activities and to encourage better coordination and cooperative governance, this policy offers guidance to both public and private sector stakeholders in the outer space arena.[89] For the South African industry to compete successfully in international markets, a supportive regulatory environment must be established by the Council for Space Affairs. This will guarantee predictable and orderly participation by the public and private sectors in both the domestic and international space arenas.[90] This is acknowledged in the 2008 South African National Space Policy. This policy also acknowledges the need for cooperation between the public and private sectors. This is a crucial point as it gives South Africa the opportunity to expand its efforts in space exploration.

It is stated in South Africa's space strategy that the country has primarily been a net importer and consumer of space technologies.[91] Systems and subsystems must be developed to support the country's needs and expand the local industry. Minister Naledi Pandor established three major priority areas to accomplish this. The first one is environment and Earth observation, navigation, communication, and space science and exploration.[92] Secondly, functional programmes should look to give effect to innovation through mission

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85 National Space Agency Act 2008 Section 4(d).

86 Independent Communications Authority Act 13 of 2000, as amended.

87 Department of trade and Industry South Africa 'National Space Policy page' (n 75) 6.

88 *Ibid.*

89 *Ibid.*

90 *Ibid.*

91 Department of trade and Industry South Africa 'National Space Strategy' (Department of trade and Industry South Africa), 6.

92 Department of trade and Industry South Africa 'National Space Strategy' (Department of trade and Industry South Africa), 6.

development and space mission operations. Lastly, there are support programmes which seek to focus on the development of human capital, resources and structures to enable this process. [93]

The above-mentioned key focus areas unmistakably demonstrate South Africa's intention to grow a space industry that is both competitive and self-sufficient to expand and improve space activities in South Africa. This not only falls correctly within Article I of the Outer Space Treaty for exercising the country's rights, but it also shows that the country understands the possibilities presented by the Outer Space Treaty. However, there seems to be a gap between the plans that South Africa has noted, which are exciting, and the actions that have been taken to make these plans a reality. This is specifically evident when looking at the collaboration between the private and public sectors, as well as between South Africa and other African countries. Although the improvement of this relationship is noted as a key item in the nation's plans to develop the industry, there has not been much notable collaboration.

3.3 Collaboration with other spacefaring nations

South Africa is fortunate to have existing relationships with spacefaring nations such as Russia, China, the USA, the upcoming spacefaring nation of India, and other African countries through various arrangements such as BRICS (the intergovernmental organisation comprising Brazil, Russia, India, China, South Africa, Iran, Egypt, Ethiopia, and the United Arab Emirates) and the African Union. Leveraging and collaborating knowledge from these states with different backgrounds is a key success driver for South Africa. It further fits into the encouragement stated in the Outer Space Treaty that developing states are not to be left behind by the developed states as spacefaring nations engaged in the space race. Although the main objectives between the different states may differ, all of these states have an opportunity to collaborate and push their different agendas forward. This section will investigate some relationships that South Africa may leverage.

3.3.1 Russia

In October 1957, the Soviet Union launched Sputnik, the first artificial satellite.[94] In less than a month, the Soviet followed up with Sputnik 2, which launched the first mammal into space.[95] Subsequently, in 1961,Yuri Gagarin became the first human in space.[96] These developments convinced the world that the Soviet Union was ahead in the space race. However, after the USA performed the first human landing on the Moon in 1969, it seemed as though the USA had overtaken the Soviet Union and was winning the space

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93 Department of trade and Industry South Africa 'National Space Strategy' (Department of trade and Industry South Africa), 6.

94 Steven Markovich et al., 'Space Exploration and U.S. Competitiveness', Council on foreign relations 2021, https://www.cfr.org/backgrounder/space-exploration-and-us-competitiveness. accessed 12 March 2021.

95 Adam Mann, 'What Was the Space Race? 2019, https://www.space.com/space-race.html accessed 29 August 2021.

96 History.Com editors 'Soviet Union' 27, 2021, https://www.history.com/topics/russia/history- of-the-soviet-union" accessed 04 May 2021.

race.[97] When the Soviet Union ceased to exist in 1991, the Russian Federation took over the rights and obligations of the Soviet Union and took on the legal personality of the Soviet Union.[98]

The Law on Space Activity is the main domestic space legislation that Russia uses to regulate space activities.[99] Article VIII of the Law on Space Activity gives effect to the Federal Space Programme.[100] The main goal of this programme is to keep Russia abreast of new space technology and maintain its position as a powerful state in the space industry.[101] This includes the protection of populations and territories from natural and technogenic emergencies, as well as implementation of a manned programme, creation of means of launching technical equipment to space, and laying the scientific and technical groundwork for advanced space complexes and systems.[102]

The Federal Space Programme has two main stages. The first stage was the period between 2016 and 2020, when the focus was on the increasing number of spacecraft in orbit for socio-economic reasons and upgrading space technology.[103] The second stage period is between 2021 and 2025, in which further development of technology will be done by focusing on "partially re-equipping" it with new generation spacecraft, ahead of creating certain key technologies, elements, and target devices for the space complexes of highest priority, in which its development is expected after 2025.[104] The plan also highlights the possibility of a spacecraft that will perform in-depth research on the Moon.[105]

Russia has long expressed interest in working with African states and establish collaborative relationships. The Russian Progress Space Rocket Centre has cooperated with several countries in northern Africa, including Algeria, Egypt, and Tunisia, through joint development agreements.[106] Most importantly, South Africa has an existing relationship with Russia through BRICS, and various projects have already been launched. For example, Russia has opened a space junk detection facility in the North West province of South Africa.[107] This is intended to assist in warning spacecraft, such as the International Space Station,

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97 Adam Mann, 'What Was the Space Race? (n 95).

98 History.Com editors 'Soviet Union'27 April 2021 " https://www.history.com/topics/russia/history-of- the-soviet-union accessed 04 May 2021.

99 Roman Buzko 'Regulation of Space Activities in Russia', 2021 https://www.buzko.legal/content-eng/legal-regulation-of-space-activities-in-russia |accessed 02 August 2021| The Law of the Russian nation about Space Activity , decree No. 5663-1 of the Russian House of Soviets (Law on Space Activity).

100 Article 8 of the Law on Space Activities.

101 Article 8(2) of the Law on Space Activity.

102 *Ibid.*

103 Roman Buzko " Regulation of Space Activities in Russia", 2021, https://www.buzko.legal/content-eng/legal-regulation-of-space-activities-in-russia >| The Law of the Russian nation about Space Activity, decree No. 5663-1 of the Russian House of Soviets (Law on Space Activity).

104 *Ibid.*

105 *Ibid.*

106 Mustapha Iderawumi, 'Russian Space Companies to Offer Support to Boost Africa's Space Technology Development', Space in Africa 2023 < https://africanews.space/russian-space-companies-to-offer-support-to-boost-africas-space-technology-development/ > accessed 25 October 2023.

107 William Brederode 'Russia opens facility in SA's North West to help protect the ISS from space junk' 2023 < https://www.news24.com/news24/tech-and-trends/news/russia-opens-facility-in-sas-north-west-to-help-protect-the-iss-from-space-junk-20230803 > accessed 21 November 2023.

about the risks posed by space debris.[108] Furthermore, SANSA confirmed that Russia invited the BRICS representatives to assist in constructing a part of the upcoming new space station.[109] In October 2023, the BRICS Astronomy Working Group Annual Meeting engaged in their 9th annual meeting in which the Group's key project, the BRICS Intelligence Telescope and Data Network (BITDN), was flagged.[110] This project is aimed at connecting optical telescopes of the BRICS countries.

However, it should be noted that more could be done in terms of developing strategic plans that South Africa employs to collaborate with a strategic partner like Russia with its resources and experience in outer space exploration. Although it is known that Russia has plans to alienate South Africa from its relations with the West, there is no known plan that South Africa has presented for using its agenda with Russia. For example, South Africa may leverage the 2016 to 2020 plan that Russia had to advance its technology for socio-economic reasons, which may be similar to the ones that South Africa has. Therefore, it is suggested that South Africa should develop a clear plan that speaks to its strategic goals with regard to its relationship with Russia.

3.3.2 United States of America

Since the very beginning, the USA has been at the forefront of space exploration. The USA believed it was lagging behind in the Cold War rivalry and needed to gain ground in the space race after Russia launched Sputnik. This encouraged the USA government to make significant investments in research. Consequently, soon after Sputnik's success they declared their intention to execute the first landing on the Moon.[111] Following the Apollo 11 mission's successful landing of a man on the Moon in 1969, the United States was seen as leading the space race. This gave them the chance to create new laws and policies that would push the envelope even further. Because of its standing in the global space industry, the USA has opened up the market to private sector competition. Leading the way in space research and activities are private organisations such as Virgin Galactic, Blue Origin, and SpaceX.[112]

The original Commercial Space Launch Act was modified further in 2015 with the passage of the Commercial Space Launch Competitiveness Act.[113] The Commercial Space Launch Competitiveness Act permits private organisations to own resources resulting from asteroid mining, and encourages private

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108 *Ibid.*

109 *Ibid.*

110 BRICS Astronomy 'The 9th Annual BRICS Astronomy Working Group Meeting' 2023 < https://www.bricsastronomy.org/the-9th-annual-brics-astronomy-working-group-bawg-meeting/ > accessed 21 November 2023.

111 Roman Buzko 'Regulation of Space Activities in Russia', 2021, *https://www.buzko.legal/content-eng/legal-regulation-of-space-activities-in-russia* | The Law of the Russian nation about Space Activity, decree No. 5663-1 of the Russian House of Soviets (Law on Space Activity).

112 *Ibid.*

113 Commercial Space Launch Amendments Act of 2004| commercial space launch competitiveness act of 2015.

spaceflight. The American space laws that have been incorporated into Title 51 of the United States Code are codified in this section. Code 51303 states as follows:

> "A United States citizen engaged in commercial recovery of an asteroid resource or a space resource under this chapter shall be entitled to any asteroid resource or space resource obtained, including to possess, own, transport, use, and sell the asteroid resource or space resource obtained in accordance with applicable law, including the international obligations of the United States."[114]

This particular clause, which has been seen as controversial, allows the private sector to permanently own certain portions of space, including its resources resulting from space mining. This is due to the current lack of clarity in international space law regarding the permissibility of commercialising space resources .[115] Although It is unclear whether the Outer Space Treaty forbids the extraction of space resources, it can be argued that the USA and Luxembourg appear to hold the opinion that extraction is not prohibited by the treaty, as evidenced by the fact that these states appear to have passed legislation allowing for the possibility of extraction.

The American astronomy industry has managed to build successful collaborations with the private sector. For example, in 2011 NASA stopped using its space shuttle programme and relied on another spacefaring nation and competitor, Russia, to launch astronauts into space, thereby building its dependency on Moscow. However, given the recent investments into the private sector, particularly with SpaceX, the USA has soon been able to launch astronauts through Boeing's Starliner capsule.[116] In June 2023, NASA announced that it would partner with seven privately owned entities to advance outer space capabilities.[117] NASA is partnering with these entities, looking specifically at their areas of focus to assist the state's missions. For example, Blue Origin will be mandated to develop an integrated commercial space transportation capability that ensures safe, affordable, and high-frequency US access to orbit for crews and other missions.[118] SpaceX is collaborating with NASA on an integrated low Earth orbit architecture to provide a growing portfolio of technology with near-term Dragon evolution and concurrent Starship development.[119] These are strategic partnerships that not only develop the country's plans but also advance the capabilities of the private sector.[120]

As noted previously, there is a gap between the South African astronomy private and public markets, where there is a lack of collaboration. The USA is a prime example of how legislation and private partnerships may propel the country's plans. With such partnerships, not only will South Africa be able to advance its

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114 Commercial Space Launch Amendments s 51.

115 *Ibid.*

116 Sarwat Nasir, 'Space exploration has become the private sector's final frontier', The national news 2023 <https://www.thenationalnews.com/weekend/2023/06/02/space-exploration-private-sector-asteroids-iss/ > 15 August 2023.

117 Roxana Bardan, 'Seven US Companies Collaborate with NASA to Advance Space Capabilities', National Aeronautics and Space Administration 2023 https://www.nasa.gov/news-release/seven-us-companies-collaborate-with-nasa-to-advance-space-capabilities/ accessed 15 August 2023.

118 *Ibid.*

119 *Ibid.*

120 *Ibid.*

own plans, but it will also build investor security around the space industry and encourage further development.

This is also an opportunity for developing states like South Africa to participate in the discussion. South Africa, like many other African states, has been involved in terrestrial mining for decades; therefore it has more experience in this field from the view of the actual mechanical work that needs to be done than most spacefaring nations. Although this type of mining is slightly different, the core basics of mining are the same and follow the same steps, namely, prospecting, extraction, and processing. The skills that South Africa possesses may be valuable to the discussions. Notwithstanding the complexity of South Africa's economic challenges and the political views that developing states are subject to, this is an active avenue. If done well, it could not only present unique solutions from an African perspective on the global stage, but could put South Africa in a global competitive market, creating jobs for its youth, and providing other economic opportunities.

Given the existing relationship between the USA and South Africa, there have been some projects in which the two countries have collaborated, and there seems to be more in store for them. In July 2023, a NASA delegation visited South Africa to monitor the construction of a communications facility near Matjiesfontein.[121] This facility is intended to support continuous communication for NASA's space missions, such as the Artemis project, which aims to return humans to the Moon for the first time since 1972.[122] With the mutual interest of these two states, South Africa has the responsibility to develop actionable plans for leveraging such relationships, which could assist in pointing the direction in which South Africa wants to go and enable it to plan accurately.

3.3.3 China

In the last decade, China's achievements in space activities have arguably solidified the country's position as a strong player in the space exploration industry. In 2003, China launched a human into orbit, becoming the third country to achieve this.[123] In 2011, China launched the first Chinese space station, and in 2013 it landed the Yutu rover on the lunar surface.[124] in 2021, it launched another space station. Today, China's space sector is advanced and diversified across military, research, and commercial institutions.[125]

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121 William Brederode, 'Russia opens facility in SA's North West to help protect the ISS from space junk' <https://www.news24.com/news24/tech-and-trends/news/russia-opens-facility-in-sas-north-west-to-help-protect-the-iss-from-space-junk-20230803> accessed 9 August 2023.

122 *Ibid*

123 Steven Markovich, Andrew Chatzky, and Anshu Siripurapu, 'Space Exploration and U.S. Competitiveness', <https://www.cfr.org/backgrounder/space-exploration-and-us-competitiveness> accessed 12 March 2021.

124 Fabio Tronchetti, 'Space Law and China', Planetary Science 2019, <https://doi.org/10.1093/acrefore/9780190647926.013.66> accessed 10 August 2021.

125 Special Report No. 524, September 2023, United States Institute of Peace, <www.usip.org >, 5.

Although China signed the Outer Space Treaty in 1970, it was only in the early 2000s when the Chinese state council released the first White Paper on space activities.[126] China has opted to release information on future plans of space developments on White Papers. These White Papers are not merely publications with principles, but rather special papers that determine the direction that China will take in the ensuing years in terms of space activities.[127]

Such papers included China's aspirations regarding space activities. On the one hand they showed interest in space exploration for the greater use of mankind and maintaining peace, but on the other hand it also emphasised using space to protect the interest of the state.[128] The white papers released in 2016 contain special principles for the exploration and use of outer space.[129] These special principles for the exploration and use of outer space include the principles of innovation, coordination, peace, and open development.[130]

Space activities in China have always been conducted as a security measure under military control, which has resulted in little to no development of legislation in China.[131] Moreover, China does not publish organisational and management documents that are based on military space.[132] China has always been criticised for this lack of legislative development. Authors have noted that if China does not adopt domestic space legislation, it would be against the current Chinese basic legal principles which obligate China to be transparent.[133] The lack of comprehensive domestic legislation regulating space activities will also leave a dent in economic relations between China and the private sector, including other countries.[134]

The South African National Space Agency (SANSA) signed a memorandum of understanding (MoU) with the China Satellite Network Office in December 2021 with the clear intention of collaborating through BDS Technology and Global Navigation Satellite System (GNSS) applications. In 2022, there were already talks of how the rollout would be implemented in South Africa. [135] China has included the internationalisation of their space programme within its sector and has placed special focus on African states in their space policies. The focus is on the integration of space-based infrastructure into China's Belt and Road Initiative, and the enhanced international profile of private space companies from China. [136]

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126 Katuzo Suzuki, 'Asia in Space, Space & Society Course', University of Cape Town 2016, 56-57.

127 Full text of white paper on China's space activities in 2016 <http://english.www.gov.cn/archive/white_paper/2016/12/28/content_281475527159496.htm> accessed May 2021.

128 *Ibid.*

129 *Ibid.*

130 *Ibid.*

131 Yeshchuk Olga and Anna Vasina, 'Chinese Space Law: Problems and Areas of Reforming' (Advanced Space Law journal 2019), 141.

132 *Ibid.*

133 *Ibid.*

134 *Ibid.*

135 Special Report No. 524, (n 125), 12.

136 *Ibid,5.*

South Africa as a developing country has placed a high priority on developing space capabilities to address socio-economic issues through collaboration, whilst China has the need to internationalise its space programme. This makes for a perfect combination between the two states. South Africa needs the capabilities and strength of a spacefaring nation like China, whilst China needs the developing states to advance its agenda. Therefore, both states must take advantage of this opportunity.

3.3.4 The African Union and state collaboration

There are currently more than 3 000 operational satellites in orbit around planet Earth. The United States owns more than 60% of the satellites, Russia owns about 5.8%, China 13.7% and the remaining 29% are owned by other countries.[137] Of this 29%, only 1.8% is attributable to African states with a total of about 58 satellites out of 55 countries.[138] Out of the 58 satellites about half are attributable to South Africa and Egypt.[139] On the other hand, there are developments in Ghana and Algeria in the emerging outer space industry to be taken note of. This section will explore the possible benefits that may be acquired from the collaboration of African states through avenues like the African Union.

The African Union enacted the African Space Agency Act, which gave rise to the African Space Agency (AfSA). The main function of the AfSA is to implement the Africa Space policy and the African Space strategy. This Agency was also granted the power to enforce collaborations within states. In January 2023 the AfSA was officially inaugurated, which marked the commencement of its operations.[140] Following this, the African Union has endorsed the recruitment of about 150 staff in three phases for a diverse array of technical and administrative positions to run the agency.[141] The African Space strategy, which is a document that the AfSA is intended to promote, identifies four core principles that African states should be focusing on:

- *Development of the services and products required to respond effectively to the socio-economic needs of the continent.*
- *Development of indigenous capacity to operate and maintain core space capabilities.*
- *Development of an industrial capability that is able to translate innovative ideas from research and development into the public and commercial sectors.*

137 UCS Satellite Database In-depth details on the 3,372 satellites currently orbiting Earth, including their country of origin, purpose, and other operational details. (01 January 2021) https://www.ucsusa.org/resources/satellite-database accessed 7 March 2021.

138 Mustapha Iderawumi 'Over USD 4.7 billion Spent on 58 Satellite Projects in Africa' 2023, < https://africanews.space/over-usd-4-7-billion-spent-on-58-satellite-projects-in-africa/ > accessed 22 November 2023.

139 *Ibid.*

140 Mustapha Iderawumi 'AUC Inaugurates the African Space Agency' 2023,< https://africanews.space/auc-inaugurates-the-african-space-agency/ > accessed 20 November 2023.

141 *Ibid*

- *Coordination of space activities across member states and regions to minimize duplication but maintaining sufficient critical mass.*[142]

The African outer space industry is reported to have generated about US$19.49 billion and is expected to generate more than US$22.64 billion by 2026. [143] Compared to a spacefaring nation like the USA or Russia it does not match or scratch the surface. It is clear that if African states are to compete in the outer space industry global stage, collaborations with other African states will be key. This is because African states have unique problems which are not applicable to the spacefaring nations. These unique challenges present an opportunity for African states to propose unique solutions that are cost effective. Through collaboration, African states can therefore become a force to be reckoned with.

Collaboration in resources, knowledge, and skills within the African continent has the potential to create an expanded and unified market, diversify the economic base, and increase competitiveness in the global market.[144] It further has political benefits such as encouraging a unified continent which promotes peace and growth and reduces the possibilities of conflict within countries.[145] It further allows for improvement in security, given the fact that stability will be introduced as a side effect of such collaboration.

The African Union has the mandate and ability to unite outer space capabilities within the continent. There is a clear indication that African states would like to join in the space race and form a force within the space industry. The African Union has the policies and strategies in place; however, there are very few collaborative activities that have happened within the continent. Therefore, it is suggested that the African Union becomes more active in fostering collaboration within African states on the continent.[146]

3.4 Conclusion

For South Africa to succeed in its quest to become a spacefaring nation, it is inevitable that it will have to collaborate with different stakeholders. For a start, developing states should be learning from the states that are leading the industry. South Africa may leverage different aspects such as expertise, strategy and resources through its existing relationship with Russia. The USA is a great example of collaboration with the private sector, which is an area in which South Africa is currently struggling. China, on the other hand, has deployed resources to collaborate with African countries. South Africa has active trading lines with China and may take advantage of this to improve its own plans. Lastly, the African Union has established strategies and policies that encourage collaboration within African states, and Africa has seen an increase

142 African Union Commission 'African Space Strategy for Social, Political and Economic Integration' (African Union Commission 2019), 4.
143 Space in Africa 'African Space and Satellite Industry Now Valued at USD 19.49 Billion' 2022 < https://africanews.space/african-space-and-satellite-industry-now-valued-at-usd-19-49-billion/ > accessed 20 November 2023.
144 F. O. Ndukwe 'Promoting Trade: Regional Integration and the Global Economy' (International Monetary Fund) 88 – 115, 90< https://www.elibrary.imf.org/display/book/9781589062627/ch06.xml?tabs=related%20documents > .
145 F. O. Ndukwe 'Promoting Trade: Regional Integration and the Global Economy' (n 144).
146 *Ibid.*

in participation in outer space activities. This is a great opportunity for African states to collaborate and share resources to be a force to be reckoned with.

Chapter 4

The Socio-economic Impact of the Development of Outer Space Law in South Africa

4.1 Introduction

For any state to invest in the development of outer space policy on a domestic level, there must be an economical return that would yield results. Therefore, the development of policies should not only serve as regulation and management of space activities, but should also allow for investor security in the outer space exploration market as an economic investment that yields positive economic results. This means that the developments that need to happen from a scientific, technological, and legal sphere should be accompanied by economic backing. A state's GDP expenditure reflects heavily on the effort that it is investing towards the development of space activities and consequently outer space law developments.[147] This chapter seeks to investigate how the development of outer space law may present socio-economic benefits in South Africa by delving into a case study on space mining and investigating other social benefits that may be experienced with the development of legislation.

The South African National Space Strategy recognises the socio-economic benefits presented by space exploration and space technology, such as job creation, poverty reduction, resource management, and rural development.[148] It is noted in the National Space Strategy that even though the outer space industry is a high investment costs industry, there are tremendous returns from such investments through job creation, technological know-how, scientific knowledge, and space spin-offs, amongst others.[149] This section seeks to investigate the economic benefits that may be gained from space mining in South Africa.

4.2 Economic benefits: Space mining in South Africa case study

Mining has shaped South Africa's GDP since the discovery of a diamond on the banks of the Orange River in 1867.[150] The 1880s saw the mines in Kimberley producing about 95% of the world's diamonds.[151] In 1886 the Witwatersrand Gold Rush started and led to the establishment of the city of Johannesburg, which within 10 years saw its population growing to about 100 000.[152] Today, Johannesburg is the economic and financial hub of South Africa, producing 16% of South Africa's gross domestic product, and accounts for

147 Annette Froehlich, '*Space Resource Utilization: A View from an Emerging Space Faring Nation',* (n 30).

148 Department of trade and Industry South Africa 'National Space Strategy' (Department of trade and Industry South Africa), 4.

149 Department of trade and Industry South Africa 'National Space Strategy' (Department of trade and Industry South Africa), 5.

150 'Mining in South Africa', Africa Mining IQ, < Mining in South Africa |ProjectsIQ>. Accessed 12 October 2023.

151 *Ibid.*

152 *Ibid.*

40% of Gauteng's economic activity.[153] In a 2008 survey conducted by Mastercard, Johannesburg was the only African city that was ranked among the top cities worldwide, ranking at number 47.[154]

The South African mining industry is continually adapting to changing local and international world conditions.[155] Mining in short inspired the development not only of technical sciences but also of human sciences.[156] Although the mining sector no longer dominates the South African economy as it once did, mining accounts for a major proportion of the country's foreign exchange earnings.[157] The economies of four of South Africa's nine provinces and of several large towns are dominated by mining.[158] Mining remains a cornerstone of the South African economy, making a significant contribution to economic activity and job creation.[159]

A close analysis of a table that compares information received from Campbell 2014, European Space Policy Institute 2016 and Statistics Time reflecting the GDP rankings and the budget allocation to space mining by states, shows that states with higher GDPs can invest more in the development of space activities.[160] South Africa is the only African state that appears on this table, and with one of the lowest GDPs. [161] This is remarkable to note because it shows the interest South Africa has in developing the outer space industry.

Recent technology has introduced a new form of mining, which is outer space mining or asteroid mining. Space mining or asteroid mining introduces the abundance of resources such as solar power, minerals, metals, gases, rare earth elements, helium 3 and space manufacturing materials.[162] Water has been noted as one of the most abundant resources in space, specifically on the Moon.[163] Water is not only essential for the existence of human life, but when separated into hydrogen and oxygen, it makes for a most effective rocket propellant.[164]

Rare minerals such as platinum may also be found in asteroids, which are easier to access. It is noted that an asteroid which is about 1 000 m (3 280 ft) across could yield about 100 000 tons of platinum. [165] It is estimated that a 500-ton asteroid in the constellation of Leo can yield returns of about US$25–50 billion

153 *Ibid.*
154 *Ibid.*
155 *Ibid.*
156 *Ibid.*
157 *Ibid.*
158 *Ibid.*
159 *Ibid.*
160 Keith Campbell, 'DST prioritises human capital, R&D infrastructure, innovation and new knowledge', Engineering news 2014, <https://www.engineeringnews.co.za/print-version/dst-prioritises-human-capital-rd-infrastructure-innovation-and-new-knowledge-2014-07-22> accessed 26 May 2023.
161 *Ibid.*
162 Ian Christensen et al., 'New Policies Needed to Advance Space Mining' (n 36).
163 *Ibid.*
164 *Ibid.*
165 Annette Froehlich, 'Space Resource Utilization: A View from an Emerging Space Faring Nation' (n 30).

from just a 30 metre long platinum-rich asteroid, as stated by Planetary Resources. [166] Research has shown that asteroids have more resources and far better revenue than any space mining activity on Earth.

Whilst this is an opportunity for any country to be able to access the minerals, it also presents a problem for an economy such as South Africa, which relies on terrestrial mining. This is because one asteroid can deliver more than 100 times of the platinum that is produced in South Africa in a year. This could mean that the country that accesses these minerals can gain an economic benefit to the disadvantage of countries like South Africa.[167] There are no limitations to what resources from space can do for the world. The economic importance of space mining is undeniable. Although huge capital investments are required for space mining purposes, the projected profits are extensive.

There are ongoing debates around the world on the legality of commercialising space. There are countries that are in the forefront of policy development, which allows for the commercialisation of outer space resources. The USA, Luxembourg and the United Arab Emirates have already started developing policies to allow for the commercialisation of space resources; therefore, allowing for space mining with a view to giving surety to investors.[168] This presents an opportunity for South Africa to look to add to the debates through its expertise in terrestrial mining. This may be in the form of soft law resources that can assist in policy development and provide guidelines for processes that may be followed in outer space mining territory.

As an example, space mining follows processes similar to those that are followed in terrestrial mining, which are prospecting, extraction, and processing. Processes such as electrolysis, which is a process of separating hydrogen and oxygen from water, are used on Earth every day. Other technologies such as hydrogen reduction may be used with the lunar dust (or regolith).[169] These processes may assist in using the water trapped on the Moon to provide water for astronauts, or for possible human settlements, or to even propel rockets. [170] These are processes in which South Africa has been engaged for decades. It separates the country from some of the spacefaring nations, because even though they may have the money, South Africa has been technically involved in the process of extracting minerals for decades, and there are skills such as those noted above that South Africa can tap into. Not only will this create jobs and improve the skillset of South Africa but will help eliminate some of the key worries in South Africa, such as poverty.

166 Sharma Rahul, 'Deep-Sea Mining: Economic, Technical, Technological, and Environmental Considerations for Sustainable Development', [2011] MTSJ 45, 48.

167 Annette Froehlich, 'Space Resource Utilization: A View from an Emerging Space Faring Nation' (n 30).

168 Alex Gilbert, 'Mining in Space Is Coming', Milken Institute Review 2021, <https://www.milkenreview.org/articles/mining-in-space-is-coming> accessed 10 October 2023.

169 Ian Christensen et al., 'New Policies Needed to Advance Space Mining' (n 36).

170 Ian Christensen et al., 'New Policies Needed to Advance Space Mining' (n 36).

4.3 Other benefits presented by space exploration and technology

South Africa as a developing state is faced by many social issues that are different from those of spacefaring nations. As an example, according to the World Bank, South Africans who live in poverty amount to 55% of the population, whilst 25% of the population is contracted with food poverty. [171] In 2017, only 55% of South Africa's learners successfully completed secondary school, whilst in 2015, only 14 per cent of learners who started primary education enrolled for tertiary education after 12 years.[172] Moreover, more than a quarter of students enrolled for tertiary education dropped out in their first year of study. With limited resources, South Africa does have to look at other options that may be viable to solve the problem faster, but on a much bigger scale.

In the education sector, space technology was notable during the Covid-19 pandemic, when a project such as the Khula Education initiative gave rural communities access to the internet through satellite broadband.[173] The project provided iPads and laptops to students to foster access to education. This not only assisted in allowing learners access to a wider range of information, but also assisted in providing long-distance learning for those learners who were unable to access schools due to various reasons, like natural disasters.[174] When natural disasters or pandemics occur, learners may continue learning. Furthermore, space exploration topics being included in the learning curriculum topics often spark students' curiosity and imagination and encourage youths of both genders to become increasingly involved in the sciences.[175]

The issues noted above can be solved by the country's improved involvement in space exploration research and technology development. As an example, data from satellites and algorithms may assist in locating the most impoverished areas in the country.[176] This is done through nighttime images from satellites, which can reflect communities that have electricity and those that do not.[177] Night-time electricity impacts the ability of the community's involvement in the economy. With this technology, government is able to allocate resources to the communities that are in need.

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171 Cleo Hudson, 'Poverty & Equity Brief South Africa Sub-Saharan Africa', World Bank 2020, Global_POVEQ_ZAF.pdf (worldbank.org) accessed 23 November 2023.

172 Montfort Mlachila and Tlhalefang Moeletsi 'Struggling to Make the Grade: A Review of the Causes and Consequences of the Weak Outcomes of South Africa's Education System' (International Monetary Fund 2019), 5.

173 Mustapha Iderawumi, 'Leveraging Space Technologies to Achieve SDG 4 – Quality Education', Space in Africa 2021, < https://africanews.space/leveraging-space-technologies-to-achieve-sdg-4-quality-education/> accessed 02 November 2023.

174 *Ibid.*

175 *Ibid.*

176 *Ibid.*

177 Space in Africa 'Researchers Use Night-time Satellite Images To Map Access to Electricity In Sub-Saharan Africa' (Space in Africa 2019), < https://africanews.space/researchers-use-night-time-satellite-images-map-electricity-access-in-sub-saharan-africa/ > accessed 12 November 2023.

Space technology can also be useful in monitoring natural and manmade disasters. In 2023 alone, South Africa has experienced multiple flooding reports in different parts of the country.[178] Satellites are able to track natural disasters and pinpoint areas that will be affected and those that are already affected.[179] This allows the country to pre-empt the assistance that will be needed and therefore it can deploy resources accordingly. This can assist not only in mitigating the risk but can also help the international community to provide the correct assistance where it is mostly required.

South Africa also depends on small-scale and large-scale farming to produce food and nourish communities. Space-related applications are widely used in agriculture, which remains an important economic sector in much of Africa. Satellites are useful in helping farmers note how much they will be harvesting. If technology such as this is made available to most communities, there will be more certainty of food security in communities and consequently in the whole country.

Space technology also assists the global health space in a number of ways through advancements in the medical field, such as the formulation of new vaccines, and creation of new healthcare tools and procedures.[180] Communication of healthcare professionals by satellite can assist in providing healthcare to remote areas or disaster-stricken areas. This is called telemedicine or tele-health. Tele-epidemiology can be used for epidemic and disease monitoring.[181] This space-based technology can be used as sensors to monitor the spread of diseases, track vector populations such as mosquitoes, and assess environmental factors that contribute to disease outbreaks. This data can aid in early detection and response to epidemics.[182]

4.4 Conclusion

The possibility of space mining seems imminent. However, international policies have not been adequately developed to match this imminent reality. An opportunity is presented to South Africa in that it is a mining country with experience ranging in decades. This is an avenue for South Africa to explore in developing its economic capabilities in future. There are also other benefits in investing in space technology in different fields, such as education, medicine, and agriculture. These benefits are only attainable if the state invests in policy development of outer space law and provides the budget for growth in this exciting field.

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178 OECD '*The Space Economy in Figures: How Space Contributes to the Global Economy*', (OECD Publishing 2019) , Paris, 41, 52.

179 *Ibid.*

180 United Nations Office of Outer Space Affairs 'Benefits of Space: Global Health' < https://www.unoosa.org/oosa/en/benefits-of-space/global-health.html#:~:text=Telemedicine%20and%20tele%2Dhealth%3A%20Space,by%20healthcare%20professionals%20from%20afar. > accessed 12 November 2023.

181 *Ibid.*

182 *Ibid.*

Chapter 5

Conclusion and Recommendations

Technology has advanced tremendously since the Outer Space Treaty was formulated. Spacefaring nations continually develop policies to regulate new technological advancement. Developing countries like South Africa remain at the back end of technology development from a policy development perspective and otherwise. Whilst it is clear that the Outer Space Treaty needs to be developed, it is also clear that South Africa has to make actionable plans that will place it at the forefront of global discussions.

The first chapter of this paper introduced the main question that this study aims to answer, which is how South Africa could improve its contribution to the outer space industry and address its socio-economic problems by developing laws and regulations related to outer space. This question has been answered in various forms, and this chapter aims to conclude and provide recommendations based on the answers provided in the chapters.

There are two main challenges presented in the second chapter of this paper. The first is that the Outer Space Treaty does not cater for all technological developments that are currently available. Therefore, there is a need for policy development to cater for current technological developments. The second challenge is that even though developing countries such as South Africa have been granted the freedom to explore outer space and to benefit from outer space activities on the same level as spacefaring nations, South Africa has not been engaging in outer space activities and outer space law policy development at the same level as the spacefaring nations. To these two main issues, a possible solution presented is South Africa's engagement in soft law development. As a developing African country, South Africa has unique challenges and practical guidelines and solutions to these problems, which may also be presented as solutions for other states as well. This effective tool may be used by South Africa to present its expertise from a practical application of space law perspective and in further debates, whilst furthering its own interest on the world stage.

Chapter 3 presents a challenge in the form of practical application of space legislation in South Africa through its own endeavours and through collaborations with other countries. Even though South Africa does not have as much resources as the spacefaring nations, it has other outer space technological landmarks such as the SKA. It has developed policies, strategies, and committees to assist in achieving its goals. However, it is still lacking in terms of technological and infrastructure advancement. One of the key solutions presented to this is collaboration. South Africa has strong ties with spacefaring nations like Russia, China and the USA. In some instances, agreements are already in place that will allow South Africa to engage in space activities with these countries. It is submitted that South Africa should learn from these countries what their key strengths are and include these in its own development plans. South Africa is also a member of the African Union. This Union already has plans to foster collaborations between African countries, but

which do not seem to be happening in the manner in which it should be. It is submitted that the African Union should develop practical ways of engaging African countries, especially those that already have effective space programmes, such as South Africa, Ghana, Nigeria, Egypt and Algeria.

As previously mentioned, South Africa as a developing country has unique problems which the spacefaring nations do not have, such as poverty, and lack of education and resources. Although many may argue that developing countries such as South Africa should stick to alleviating these problems, it is submitted that investment in outer space policy development may help South Africa solve these problems. Exploring the possibility of outer space mining may not only allow for job creation but may also secure the future economy of South Africa, which is under threat of space mining by spacefaring nations that previously depended on South Africa for minerals. There are also social benefits that space technology allows for, such as access to education, facilitating surety in agriculture to provide food security, as well as advancement in medical technology.

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