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PLAGIARISM DECLARATION:

'I, Ayesha Logday, declare that *Space Debris and the BRICS countries: The Role of International Environmental Law* is my own work, that it has not been submitted before for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated and acknowledged as complete references'.

Signed:

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KEYWORDS

- Space Debris
- Orbital Debris
- Developing States
- Space Objects
- Space Junk
- BRICS (Brazil, Russia, India, China and South Africa)
- The IADC Guidelines
- The Outer Space Treaty
- The COPUOS Guidelines
- Outer Space
- Low Earth Orbit
- Geosynchronous Earth Orbit

ACRONYMS

BRICS	Brazil, Russia, India, China and South Africa
CBDR	Common but Differentiated Responsibilities
CBDR&RC	Common but differentiated responsibilities and respective capabilities
CHM	Common Heritage of Mankind
COPUOS	United Nations Committee on the Peaceful Uses of Outer Space
GEO	Geostationary Orbit
IADC	The Inter-Agency Space Debris Coordination Committee
IEL	International Environmental Law
ITU	International Telecommunications Union
LEO	Low Earth Orbit
SANSA	South African National Space Agency
SUNSAT	The Stellenbosch University Satellite
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
UNSG	Secretary-General of the United Nations
OST	Outer Space Treaty

ABBREVIATIONS

The Liability Convention	Convention on International Liability for Damage Caused by Space Objects (resolution 2777 (XXVI) adopted on 29 November 1971, entered into force on 1 September 1972.
The Moon Treaty	Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (resolution 34/68) adopted on 5 December 1979, entered into force on 11 July 1984.
OST	Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (General Assembly resolution 2222 (XXI), adopted on 19 December 1966, entered into force on 10 October 1967.
The Paris Agreement	The Paris Agreement adopted on 12 December 2015 at the Conference of the Parties to the United Nations Framework Convention on Climate Change held in Paris from 30 November to 13 December 2015.
The Registration Convention	Convention on Registration of Objects Launched into Outer Space (resolution 3235 (XXIX) adopted on 12 November 1974, entered into force on 15 September 1976.

The Rescue Agreement	Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (resolution 2345 (XXII) adopted on 19 December 1967, entered into force on 3 December 1968.
The Rio Declaration	The 1992 United Nations Conference on Environment and Development held in Rio Declaration.
The Stockholm Declaration	The 1972 United Nations conference on the Human Environment.
The Guidelines	The Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space.

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CHAPTER ONE: INTRODUCTION

Environmental Law is at the forefront of the global community and environmental protection and conservation is regarded as of the utmost importance.[1] Outer Space is a unique, limited, and valuable resource. Outer space allows states to utilise thousands of satellites for research, national defence, and communications. At the inception of space law, only a few states dominated space activities and all human space activities were so challenging that nearly any method seemed acceptable for placing objects in outer space, currently more countries have space industries and launch capabilities.[2] As a result outer space has been significantly altered by human activity.[3] As the presence in space becomes more proliferate among nations, the amount of resulting space debris increases.[4] Human exploration and the commercialisation of space creates environmental problems in space. The most prominent being the issue of space debris.[5] Some debris occurs naturally, however the majority of space debris occur as a result of man-made objects in outer space.[6] Space debris is considered to be a problem because of its possibility to cause damage on earth and its potential to damage other spacecraft that still have a mission to fulfil and are functional.[7] Thus space debris pose a threat to life and property, both in space

[1] Hobe S 'Environmental Protection in Outer Space: Where we Stand and What is Needed to make Progress with regard to the Problem of Space Debris' (2012) 8 *Indian Journal of Law and Technology* 1.
[2] Viikari L *The Environmental Element in Space Law: Assessing the Present and Charting the Future* (2008) 4.
[3] Pusey N 'The Case for Preserving Nothing: The Need for a Global Response to the Space Debris Problem' (2010) 21 *Colorado Journal of International Environmental Law and Policy* 425.
[4] Plantz MR 'Orbital Debris: Out of Space' (2012) 40 *Georgia Journal of International and Comparative Law* 587.
[5] Ferreira-Snyman A 'The Environmental Responsibility of States for Space Debris and the Implications for Developing Countries in Africa' (2013) 46 *Comparative and International Law Journal of Southern Africa* 19.
[6] Hobe S (2012) 1.
[7] Hobe S (2012) 3.

and upon its re-entry into the Earth's atmosphere.[8] Space debris is dangerous because it can destroy larger space objects such as satellites.[9] This has led to considerable environmental threats that constitute increasing hazards to the environment of outer space as well as to human space activities.[10] The socio-economic benefits of using outer space have also made the development of space programmes attractive to a number of developing States.[11] The BRICS (Brazil, the Russian Federation (Russia), India, the People's Republic of China (China), and the Republic of South Africa (South Africa)) countries are vying to become space-faring nations and have placed a priority on space utilisation.[12] Space activities are becoming more of a necessity, as States regard them as an important political investment in the future.[13] The space environment is far less resilient than the Earth, as many parts of outer space cannot regenerate after disturbances in the way the terrestrial environment typically does.[14] The objects left behind in outer space have not disappeared, and their numbers continue to grow with continued space use and collisions among existing space debris.[15] These collisions could eventually clutter outer space so densely that it would be impossible to access space.[16] This has far-reaching implications, beyond losing the ability to engage in space exploration, nations will lose access to satellite systems on which they rely for defence, surveillance, and telecommunications.[17] States have yet to make any significant developments to

[8] Plantz MR (2012) 587.
[9] Hobe S (2012) 1.
[10] Viikari L (2008) 4.
[11] Ferreira-Snyman A (2013) 19.
[12] Imburgia JS 'Space Debris and Its Threat to National Security: A Proposal for a Binding International Agreement to Clean Up the Junk' (2011) 44 *Vanderbilt Journal of Transnational Law* 606.
[13] Ferreira-Snyman A (2013) 19.
[14] Viikari L (2008) 4.
[15] Hollingsworth G 'Space Junk: Why the United Nations Must Step in to Save Access to Space' (2013) 53 *Santa Clara Law Review* 240.
[16] Hollingsworth G (2013) 240.
[17] Hollingsworth G (2013) 240.

reduce the amount of debris in outer space.[18] The current space law does not adequately address the urgent problem of space debris.[19] The effects of human activities on the global commons of outer space can be severe, irreversible and wide in scope.[20] A global solution to the space debris problem must be developed and implemented before a catastrophic event causes irreparable harm.[21] International treaties was drafted to address space law, however the current international legal regime is insufficient to meet modern space demands and remedy current issues, including space debris.[22] International action must be taken soon in the form of a binding international agreement on space debris.[23] Without legal consequences, including appropriate international sanctions for treaty violations, little international influence exists to force space-faring nations to find a concrete solution to this problem.[24]

1.1 RESEARCH QUESTION

What are the rights and obligations of the BRICS countries with regard to the prevention and minimisation of risks related to space debris?

1.2 RESEARCH OBJECTIVES

a) To investigate the current international environmental regime regarding space debris.

[18] Pusey N (2010) 426.
[19] Hollingsworth G (2013) 266
[20] Viikari L (2008) 5.
[21] Plantz MR (2012) 587.
[22] Plantz MR (2012) 587.
[23] Imburgia JS (2011) 592.
[24] Imburgia JS (2011) 592.

b) To establish whether the current international environmental regime is appropriate, effective and adequate.

c) To determine the role and responsibility the BRICS countries will have towards mitigating the problem of space debris.

1.3 AIM/S OF THE RESEARCH

The aim of this research is to provide for a better understanding regarding space debris and international environmental law. In order to allow the reader to become familiar with the current international legal regime in place regarding space debris. My aim is to create awareness surrounding the difficult practical problem of space debris and what contribution international environmental law, if any, can offer to curb the problem of space debris. This study can be used as a point of departure for further study and elaboration on space debris and the BRICS countries. I will highlight the shortcomings of the current international legal regime in order to indicate why there is a need for an updated international convention.

1.4 SCOPE

This research paper will focus on international environmental law and the problem of space debris from a BRICS country perspective. This research paper will not deal with the domestic laws of the BRICS countries.

1.5 SIGNIFICANCE OF THE RESEARCH

This paper seeks to evaluate the current legal regime of space debris. This particular study is significant as an increasing number of BRICS countries are engaging in space

activities, and this research paper highlights the role and responsibility the BRICS countries will have towards mitigating the problem of space debris.

1.6 RESEARCH METHODOLOGY

The methodology which I will be adopting is termed 'desk' study and library research. This research comprises of the gathering and analysing of information, which is already available in print or published on the internet.[25] Furthermore, this research is conducted by reviewing the literature published through primary and secondary sources which include articles in journals, academic books, newspapers, web publications, policies, laws and original narratives by independent researchers, and academic scholars. Since the topic deals with international environmental law, there will also be an analysis of international law. This will include exploring treaties and conventions. There will also be a historical analysis in order to understand the current international legal system and principles.

1.7 PROPOSED CONTENT

The research paper will consist of six chapters including the introductory chapter.

Chapter two will define 'outer space', 'space debris' and 'popular orbits'. The socio-economic benefits of outer space utilisation will be discussed. Furthermore, the risks and problems associated with space debris will be highlighted in this chapter.

In chapter three I will analyse the current international law dealing with space debris. I will evaluate the binding international treaties relevant to space debris such as: The Outer Space Treaty; The Liability Convention; The Registration Convention; The

[25] The Business Dictionary available at *http://www.businessdictionary.com/definition/desk-research.html* (accessed 8 August 2016).

Rescue Agreement and The Moon Treaty. I will also discuss the non-Binding International Space Debris Mitigation Guidelines.

In chapter four I will consider the established international environmental norms such as Principle 21 of the Stockholm Declaration; sustainable development; the common but differentiated responsibility; the precautionary principle, and the polluter pays principle to space debris.

In chapter five I will discuss BRICS as emerging space fairing nations.

Furthermore, chapter six will contain my concluding remarks.

CHAPTER 2: SPACE DEBRIS

2.1 INTRODUCTION

Outer space is a valuable resource, whereby states can utilise satellites for research, national defence, and communications. However, human exploration and the commercialisation of outer space creates environmental problems in outer space. The most prominent being the issue of space debris.[26] Space debris poses a threat to life and property, both in outer space and upon its re-entry into the Earth's atmosphere.[27] This chapter aims to ensure that all the relevant terms such as 'outer space', 'popular orbits' and 'space debris' is explained. This chapter will elaborate on the socio-economic benefits of outer space utilisation, as well as the risks and problems associated with space debris.

2.2 DEFINING 'OUTER SPACE'

Outer space is considered as something huge and beyond our environment.[28] However outer space is not outside of our influence.[29] There is no international consent on where the earth's atmosphere ends and outer space begins.[30] The generally accepted altitude at which outer space begins is where the atmosphere thins as altitude increases and most of the atmospheric particles disappears by 100

[26] Ferreira-Snyman A (2013) 19.
[27] Plantz MR (2012) 587.
[28] Button M 'Cleaning Up Space: The Madrid Protocol to the Antarctic Treaty as a Model for Regulating Orbital Debris' (2013) 37 *William & Mary Environmental Law and Policy Review* 539.
[29] Button M (2013) 539.
[30] Button M (2013) 541.

kilometres.[31] The outer space discussed in this paper, is limited to the orbital area immediately surrounding earth, which is commonly used for satellites.[32]

2.3 POPULAR ORBITS

The most useful areas of outer space are the orbits nearest to earth.[33] The primary levels of orbit used for satellites are Low Earth Orbit ("LEO") and Geosynchronous Earth Orbit ("GEO").[34] Both orbits are congested with satellites and therefore space debris increases in these areas.[35]

2.3.1 LOW EARTH ORBIT ("LEO")

LEO, is the closest orbit to earth, it occupies the atmospheric space from an altitude of 100 kilometres above the earth's sea level to 1 000 kilometres above sea level.[36] Remote sensing satellites use LEO since cameras or radars receive better resolution in LEO than they would in higher orbits.[37] All manned spaceflight, takes place in LEO.[38] A satellite in LEO takes approximately 100 minutes to make a complete rotation around the earth, therefore making LEO useful for satellites that need to view the earth quickly.[39] LEO's close proximity to earth and its quick orbit makes it in demand and the most congested orbit in space, this congestion also makes LEO one of the most hazardous areas of space since there is a greater risk of collision.[40] Space debris can

[31] Taylor MW 'Trashing the Solar System One Planet at a Time: Earth's Orbital Debris Problem' (2007) 20 *Georgetown International Environmental Law Review* 4.
[32] Button M (2013) 541.
[33] Plantz MR (2012) 590.
[34] Button M, (2013) 541.
[35] Taylor MW (2007) 5.
[36] Plantz MR (2012) 590.
[37] Taylor MW (2007) 6.
[38] Taylor MW (2007) 6.
[39] Plantz MR (2012) 591.
[40] Plantz MR (2012) 591.

remain in LEO from a couple to a few hundred years.[41] Debris that remain in LEO poses a navigational hazard for other satellites operating in that region.[42] With more space debris being accumulated, LEO is becoming dangerous unless a solution to mitigate space debris is found.[43]

2.3.2 GEOSYNCHRONOUS EARTH ORBIT ("GEO")

The second most demanded earth orbit, GEO, occupies the atmospheric space 35 787 kilometres above sea level.[44] Most satellites engaged in commercial communications are in GEO.[45] In this orbit, satellites rotate at the same speed as earth and therefore remain over an exact location on the earth's surface, such as a country.[46] This is a popular orbital position for satellites because they are able to remain stationary over a specific position on earth to continuously serve that region's communications and remote sensing needs.[47] Satellites in GEO can observe nearly half of the earth, making this orbit useful for broadcasting, weather, and telecommunications satellites.[48] Only a limited number of satellites can use GEO because satellites must maintain separation from each other in order to avoid collisions and radio communication frequency interference.[49] Therefore positions in GEO is very competitive for satellite operators.[50] The International Telecommunications Union (ITU), an organisation of the United Nations (UN),

[41] Plantz MR (2012) 591.
[42] Taylor MW (2007) 6.
[43] Plantz MR (2012) 591.
[44] Plantz MR (2012) 591.
[45] Button M (2013) 541.
[46] Plantz MR (2012) 591.
[47] Irwin TR 'Space Rocks: A Proposal to Govern the Development of Outer Space and Its Resources' (2015) 76 *Ohio State Law Journal* 234.
[48] Taylor MW (2007) 6.
[49] Taylor MW (2007) 7.
[50] Plantz MR (2012) 592.

manages the allocation of geostationary objects, such as satellites.[51] GEO is a limited resource in high demand and therefore the allocation of these orbits is regulated by the ITU.[52] Satellite operators must obtain permission from the ITU to use a specific satellite position.[53] GEO has only minimal gravitational pull from the earth; thus, satellites and space debris in GEO have orbital life span in excess of one million years.[54] Satellites in GEO are in a fixed location with minimal motion and therefore they do not have to be tracked, this makes the cost of operating satellites in GEO less than other orbits.[55] Functioning GEO satellites must manoeuvre to avoid collisions with the debris, causing problems for satellite operators.[56]

2.4 DEFINING 'SPACE DEBRIS'

There is no legal definition of 'space debris'.[57] Space debris can be referred to as space junk or space waste.[58] The layperson definition of space debris would be garbage that orbits around the earth in outer space.[59] Space debris occurs in two ways, namely 'naturally occurring debris' and 'man-made debris'.[60] Naturally occurring debris include meteoroids, while man-made space debris are generated by manned and unmanned space programmes.[61] Space debris is debris left over from objects launched into outer space and includes everything from derelict satellites to lost screwdrivers.[62] Man-made space debris are more dangerous than naturally occurring

[51] Plantz MR (2012) 592.
[52] Irwin TR (2015) 234.
[53] Plantz MR (2012) 592.
[54] Plantz MR (2012) 591.
[55] Plantz MR (2012) 591.
[56] Taylor MW (2007) 7.
[57] Ferreira-Snyman A (2013) 23.
[58] Plantz MR (2012) 592.
[59] Sethu & Singh 'Stuck in Space: The Growing Problem of Space Debris Pollution' (2014) 2 *UK Law Student Review* 97.
[60] Sethu & Singh (2014) 97.
[61] Sethu & Singh (2014) 97.
[62] Button (2013) 543.

debris because they are permanently scattered in the orbital zones during entire lifetime, thereby posing a risk over a greater period of time, whereas the meteoroids are transient and exist only in the near-earth environment.[63] Space debris orbits the earth until it deorbits and burns up in the atmosphere, although for some debris, this will not occur for millions of years.[64] The type of space debris is treated differently in terms of the Inter-Agency Space Debris Coordination Committee (IADC) guidelines.[65] One is short-term debris in LEO**,** which must be deorbited within twenty-five years.[66] Another is the long-term debris in GEO, which cannot be deorbited within twenty-five years but must be sent out into a grave yard orbit before it becomes defunct.[67] The term "space debris" lacks an internationally agreed upon and legally binding definition.[68] However, the term "*space object*" is defined in several international treaties.[69] These definitions vary, indicating that the meaning of the term "*space object*" is unclear.[70] However, according to some definitions, the term may include objects that typically fall under the popular use of the term "space debris," such as inactive satellites or operational debris.[71] If "*space object*" is determined to include "*space debris*", then several treaties already in place will regulate the problems of space debris.[72]

[63] Sethu & Singh (2014) 97.
[64] Hollingsworth G (2013) 241.
[65] Larsen PB 'Solving the Space Debris Crisis' (2018) 83 *Journal of Air Law & Commerce* 479.
[66] Larsen PB (2018) 479.
[67] Larsen PB (2018) 479.
[68] Imburgia JS (2011) 613.
[69] Seymour JM 'Containing the Cosmic Crisis: A Proposal for Curbing the Perils of Space Debris' (1998) 10 *Georgetown International Environmental Law Review* 898.
[70] Seymour JM (1998) 898.
[71] Seymour JM (1998) 898.
[72] Seymour JM (1998) 898.

2.5 SOCIO-ECONOMIC BENEFITS OF OUTER SPACE UTILISATION

Humans have spread its active environment from Earth into outer space.[73] Satellites being an achievement that has enabled development. Satellite navigation systems are used for positioning purposes in transportation, it provides us with data for meteorological services including; weather forecasts; land and agriculture management; environmental planning and mapping; and telecommunications.[74] Satellites enable many of the communications (i.e. phone, internet, television) and banking operations that have become the primary modes of social interaction and of the world's economy.[75] Telecommunication satellites, provide access to the Internet, which has become a vital tool for easy and instant transmission of information across the world.[76] Satellites help save lives by supporting disaster relief and search and rescue missions.[77] Remote sensing is the observation of the Earth's surface from outer space for improving natural resources management, land use and protection of the environment.[78] Apart from its application for economic development and humanitarian purposes, it has potential for support to military objectives.[79] The progress in space and technology has brought improvements to human life.[80]

[73] Viikari L (2008) 3.
[74] Viikari L (2008) 3.
[75] Koplow DA 'The Fault Is Not in Our Stars: Avoiding an Arms Race in Outer Space' (2018) 59 *Harvard International Law Journal* 334.
[76] Koroma AG 'The Development of International Law and the Peaceful Uses for Outer Space' (2011) 54 *Proceedings of the International Institute of Space Law* 11.
[77] Koplow DA (2018) 334.
[78] Koroma AG (2011) 11.
[79] Koroma AG (2011) 12.
[80] Supancana IBR 'Commercial Utilization of Outer Space and its Legal Formulation Developing Countries Perspectives' (1991) 34 *Proceedings on the Law of Outer Space* 352.

2.6 RISKS AND PROBLEMS ASSOCIATED WITH SPACE DEBRIS

Earth's orbit is a vital component of the environmental system of the planet, and it has become polluted by debris.[81] Pollution in orbit is the result of space debris and the overcrowding of satellites.[82] Space debris causes a variety of problems for objects in orbit.[83] More space activity occurs in LEO thus making LEO more heavily concentrated with debris than in GEO.[84] Objects travel rapidly in LEO, that a piece of debris just one centimetre in diameter could disable a functioning satellite upon collision.[85] Space debris is an ever-increasing problem, because as debris moves in orbit, pieces of it collide and break apart, creating more debris.[86] With the increasing growth of technology that relies on satellites, more States are beginning to utilise outer space.[87] Increasing amounts of space debris, coupled with the increasing amount of States using outer space, have put the orbits in hazardous conditions.[88] Old satellites remain in outer space as debris until natural forces or a satellite's operator return them to earth.[89] New satellites sent to replace the old ones also create debris.[90] A collision between a spacecraft and the smallest piece of space debris can cause huge damage.[91] The effect of impact between space debris and a spacecraft depends on speed of both the spacecraft and the debris, the point of collision and the mass of the debris.[92] A large piece of debris can destroy a satellite with which it collides.[93] Small debris can disable or interfere with a satellite's performance; dent a space shuttle; may

[81] Button M (2013) 539.
[82] Button M (2013) 543.
[83] Pusey N (2010) 430.
[84] Pusey N (2010) 430.
[85] Pusey N (2010) 430.
[86] Button M (2013) 543.
[87] Plantz MR (2012) 592.
[88] Plantz MR (2012) 592.
[89] Taylor MW (2007) 3.
[90] Taylor MW (2007) 3.
[91] Plantz MR (2012) 595.
[92] Plantz MR (2012) 595.
[93] Taylor MW (2007) 19.

cause a functioning satellite to short circuit.[94] Tiny pieces of debris can cause significant damage and therefore action must be taken to avoid debris collisions with an operational spacecraft.[95] Other indirect effects of space debris create technical, legal, political, and economic impacts.[96] As the amount of debris increases, so does the risk of placing a new satellite into that area.[97] These consequences show the importance keeping the space environment sustainable for future use.[98] Certain areas of space that are already crowded with debris are susceptible to the creation of new debris.[99] Orbital slots and radio spectrum, which are provided by the ITU, have now become scarce resources, because advancements in technology and demand for high-speed data communications have caused outer space to become congested with satellites.[100] When these satellites become obsolete, they continue to orbit the earth, resulting in new-comers having to spend enormous amounts of labour, time and money to place their satellites into space.[101] The accumulation of debris will hamper the access to outer space. Most debris are too small to be tracked and are therefore unavoidable.[102] Collisions between debris and functioning satellites, cause monetary harm to the owners of satellites and environmental damage.[103] Once a satellite is damaged in a collision it can lose its ability to correct its orbit, and become a hazard in space, being unable to steer onto a better orbital path, this increases the chance of a damaged satellite careening into some other orbiting object, and thus continuing the cycle of debris generation.[104] This poses a serious threat to spacecraft and

[94] Taylor MW (2007) 19.
[95] Plantz MR (2012) 596.
[96] Taylor MW (2007) 19.
[97] Taylor MW (2007) 20.
[98] Plantz MR (2012) 596.
[99] Taylor MW (2007) 20.
[100] Sethu & Singh (2014) 101.
[101] Sethu & Singh (2014) 101.
[102] Larsen PB (2018) 477.
[103] Button M (2013) 544.
[104] Button M (2013) 544.

astronauts.[105] The objects left behind in orbit continue to increase with continued space use and collisions among existing space debris.[106] These collisions could clutter the earth's orbit so densely that it would be impossible to continue space missions.[107] More countries are aspiring to implement space programs.[108] Besides losing the ability to engage in space exploration, countries will lose access to satellite systems on which they rely for defence, surveillance, and telecommunications.[109] As the demand for orbital space increases, due to advancing technology that requires satellite operations, the potential for space debris also increases.[110]

2.7 CONCLUSION

The increasing presence of space debris in both GEO and LEO poses one of the greatest practical threats to the continued modern exploration and use of outer space.[111] It seems improbable that in such an infinite area space debris would be a hazard to current and future operations in space.[112] Human exploration and use of outer space has not only made enormous contributions to the welfare of society, but has also resulted in a large number of debris in orbit.[113] Space debris is an increasing problem that requires international attention immediately.[114] This chapter provided a factual exposition for the subsequent legal analysis. The UN has addressed the issue of space debris, but has yet to develop a system capable of fixing this imminent

[105] Ferreira-Snyman A (2013) 25.
[106] Hollingsworth G (2013) 240.
[107] Hollingsworth G (2013) 240.
[108] Hollingsworth G (2013) 247.
[109] Hollingsworth G (2013) 240.
[110] Plantz MR (2012) 592.
[111] Wouters J, De Man P & Hansen R 'Space Debris Remediation, Its Regulation and the Role of Europe' (2016) 18 *European Journal of Law Reform* 66.
[112] Taylor MW (2007) 11.
[113] Su J 'Active Debris Removal: Potential Legal Barriers and Possible Ways Forward' (2016) 9 *Journal of East Asia and International Law* 404.
[114] Plantz MR (2012) 595.

problem.[115] The next chapter will address the International Environmental Law framework dealing with outer space.

[115] Hollingsworth G (2013) 240.

CHAPTER 3: INTERNATIONAL LAW DEALING WITH OUTER SPACE

3.1 INTRODUCTION

The dangers of space debris as described in chapter 2 may be mitigated through a binding international agreement on space debris.[116] There is no international treaty that specifically address the problems associated with space debris although several treaties may affect it.[117] The legal regime that currently regulates outer space comprises of five UN treaties/agreements they are as follows:

1. Treaty on Principles Governing the Activities of States in the Exploration and use of Outer Space, including the Moon and Other Celestial Bodies of 1967[118] (hereinafter "OST");
2. Convention on International Liability for Damage Caused by Space Objects of 1972[119] (hereinafter "the Liability Convention");
3. Convention on Registration of Objects launched into Outer Space of 1975[120] (hereinafter "the Registration Convention");
4. Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space[121] (hereinafter "the Rescue Agreement") of 1968; and

[116] Imburgia JS (2011) 611.
[117] Seymour JM Debris' (1998) 898.
[118] Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies General Assembly resolution 2222 (XXI) 1967 (1967) 6 ILM 386.
[119] Convention on International Liability for Damage Caused by Space Objects (resolution 2777 (XXVI) 1971 (1971) 10 ILM 965.
[120] Convention on Registration of Objects Launched into Outer Space (resolution 3235 (XXIX) 1975 (1975) 14 ILM 43.
[121] Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (resolution 2345 (XXII) 1968 (1968) 7 ILM 149.

5. Agreement Governing the Activities of States on the Moon and other Celestial Bodies of 1979[122] (hereinafter “the Moon Treaty”).

In this chapter the current international law dealing with outer space will be analysed. Furthermore, this chapter will highlight the non-Binding International Guidelines relevant to space debris.

3.2. THE OUTER SPACE TREATY (“OST”)

The first treaty dealing with outer space was the Outer Space Treaty. The OST is the foundation of the international legal order in outer space.[123] This treaty was developed at the commencement of space activities when space missions were rare resulting in the treaty not being comprehensive enough.[124] Although this treaty is silent on space debris, it serves as a framework for subsequent treaties governing outer space.[125] The OST establishes basic principles governing states' activities in outer space, including a prohibition on claims of sovereignty,[126] a prohibition on placing weapons of mass destruction in space,[127] and a requirement that space exploration be carried out for the benefit of all countries as "*the province of all mankind*" (Article I).[128] The OST also contains general provisions on assistance to astronauts,[129] international responsibility for all national space activities,[130] and jurisdiction over space objects.[131] Article VIII of

[122] Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (resolution 34/68) 1979 (1979) 18 ILM 1434.
[123] Imburgia JS (2011) 614.
[124] Hollingsworth G (2013) 255.
[125] Hollingsworth G (2013) 255.
[126] Article II of the 1967 OST.
[127] Article IV of the 1967 OST.
[128] Wessel B ‘The Rule of Law in Outer Space: The Effects of Treaties and Nonbinding Agreements on International Space Law’ (2012) 35 *Hastings International and Comparative Law Review* 292.
[129] Article V of the 1967 OST.
[130] Article VI of the 1967 OST.
[131] Article VIII of the 1967 OST.

the OST places liability on Parties for damaged caused by the space objects they launch or its component parts.[132] The treaty does not define "space object" nor "component parts."[133] Article I paragraph 1 provides that the *"exploration and use of outer space, including the Moon and other celestial bodies, shall be carried out for the benefit and in the interest of all countries, … and shall be the province of all mankind."*[134] It can be held that pollution of outer space with space debris violates this since such pollution is not for the benefit and in the interest of all countries.[135] Article I refers to the "*province of mankind*" therefore it can be said to define outer space as Common Heritage of Mankind ("CHM").[136] The CHM principle will be deliberated under the discussion of the Moon Treaty. Article I, paragraph 2 of the OST provides that "*outer space, including the Moon and other celestial bodies, shall be free for exploration and use by all states without discrimination of any kind, on a basis of equality and in accordance with international law".*[137] Outer space has been recognised as a *'res communis',* a resource legally incapable of exclusive ownership, or a resource belonging to everyone.[138] Outer space, like the high seas and the atmosphere, is a global commons.[139] Article I of the OST has no direct relevance concerning space debris.[140] Article II of the OST denies countries the right to claim areas of outer space.[141] The objective of Articles I and II of the OST is to encourage development of the outer space environment while encouraging equality.[142] Although

[132] Article VIII of the OST.
[133] Imburgia JS (2011) 615.
[134] Article I of the OST.
[135] Schladebach M 'Space Debris as a Legal Challenge' (2013) 17 *Max Planck Yearbook of United Nations Law* 69.
[136] Schladebach M (2013) 69.
[137] Article I, paragraph 2 of the OST.
[138] Welly ND 'Enlightened State-Interest-Legal Framework for Protecting The "Common Interest of All Mankind" From Hardinian Tragedy' (2010) 36 *Journal of Space Law* 278.
[139] Welly ND (2010) 279.
[140] Schladebach M (2013) 69.
[141] Article II of the OST.
[142] Roberts L 'Addressing the Problem of Orbital Space Debris: Combining International Regulatory and Liability Regimes' (1992) 15 *Boston College International and Comparative Law Review* 59.

space resources such as gravity and the atmosphere are renewable, encouraging their exploitation has degraded the quality of access to them.[143] Under Article V of the OST, parties are required to inform other parties or the Secretary-General of the United Nations of anything that "could constitute a danger to life or health of astronauts".[144] According to Article VI of the OST *"States Parties to the Treaty shall bear international responsibility for national activities in outer space,… , whether such activities are carried on by governmental agencies or by non-governmental entities"*.[145] Article VI of the treaty holds parties responsible for their national activities conducted in outer space.[146] The launching state is responsible for the pollution of outer space by private enterprises as laid down by Article VI of the OST, this could perhaps create legal duties regarding space debris.[147] Article VII determines the liability of the launching state if a launched "space object" causes damage to another State Party.[148] There is no adequate definition of "*space object*" in international law, this term could include space debris however the definition of "*space object*" is unclear.[149] Article VII merely regulates a compensation for damages which has already occurred and does not result in the prevention of space debris.[150] Article VIII of the OST stipulates that the launching state shall retain jurisdiction and control over space objects.[151] Article VIII requires states to return, to the state of registry, objects which accidentally land in their territory.[152] The OST holds parties to the agreement liable for damages for launching

[143] Roberts L (1992) 59.
[144] Article V of the OST.
[145] Article VI of the OST.
[146] Brearley A 'Reflections Upon the Notion of Liability: The Instances of Kosmos 954 and Space Debris' (2008) 34 *Journal of Space Law* 305.
[147] Schladebach M (2013) 69.
[148] Schladebach M (2013) 69.
[149] Imburgia JS (2011) 615.
[150] Schladebach M (2013) 69.
[151] Article VIII of the OST.
[152] Article VIII of the OST.

an object into outer space.[153] Article IX of the OST provides that: *"States Parties to the Treaty shall pursue studies of outer space,… and conduct exploration of them so as to avoid their harmful contamination…and, where necessary, shall adopt appropriate measures for this purpose. If a State Party to the Treaty has reason to believe that an activity or experiment planned by it or its nationals in outer space,… would cause potentially harmful interference with activities of other States Parties,… it shall undertake appropriate international consultations before proceeding with any such activity or experiment"*.[154]

Article IX provides for a limitation on activities that might be harmful to the space environment, requiring states to avoid harmful contamination of outer space.[155] This provision prohibits pollution of outer space and the earth's environment and represents environmental protection in outer space.[156] In terms of Article IX, the state is obliged to undertake appropriate international consultations where a state believes that its own activity may cause "*potentially harmful interference*" with activities of other State Parties.[157] These provisions however, do not restrict the activities themselves.[158] There is no definition as to what "*harmful interference*" is, thus leaving it open to interpretation.[159] Even if a strict interpretation of "*harmful interference*" is applied, the provisions of Article IX binds only states that are parties to the OST.[160] Article IX can be read to apply to space debris that would cause potentially harmful interference with the use of outer space, however it is unlikely that the treaty will be read as mandating

[153] Hollingsworth G (2013) 255.
[154] Article IX of the OST
[155] Roberts L (1992) 60.
[156] Schladebach M (2013) 70.
[157] Schladebach M (2013) 70.
[158] Roberts L (1992) 60.
[159] Hollingsworth G (2013) 256.
[160] Roberts L (1992) 61.

that every proposed space mission be subject to consultation with all spacefaring nations.[161]

The definition of "space debris" is an important aspect of space law development that needs to be addressed in a space debris treaty.[162] The gaps in the OST leave too much open for interpretation to be directly applicable to the space debris problem.[163]

3.3 THE LIABILITY CONVENTION

The Liability Convention aims to clarify the liability regime established in Article VII of the OST.[164] Unlike the OST, the Liability Convention provides for standards of proof; identifies principles of liability; identifies parties who can be held responsible; defines who can be a claimant; establishes claims procedures; and formalizes the dispute settlement process.[165] The Liability Convention, unfortunately does not clarify whether the term "space debris" falls within the ambit of the convention.[166] The Liability Convention applies strict liability to damage caused by a launching state's space object on the surface of the earth or to aircraft in flight.[167] The Liability Convention holds a launching state liable based on a negligence standard for damage caused in outer space by its space objects.[168] The Liability Convention provides that owners of space objects remain responsible for the damage their objects cause.[169] The Convention implements a fault-based system of liability, so that a launching state will not be liable

[161] Seymour JM (1998) 899.
[162] Imburgia JS (2011) 615.
[163] Hollingsworth G (2013) 256.
[164] Imburgia JS (2011) 616.
[165] Christol CQ 'International Liability for Damage Caused by Space Objects' (1980) 74 *The American Journal of International Law* 353.
[166] Imburgia JS (2011) 616.
[167] Seymour JM 1998) 900.
[168] Wessel B (2012) 293.
[169] Seymour JM (1998) 900.

for damage caused by its space objects unless that state is at fault for the damage.[170] The Convention defines "*damage*", "*launching state*" and "*space object*".[171] The term "damage" *means loss of life, personal injury or other impairment of health; or loss of or damage to property of States or of persons, natural or juridical, or property of international intergovernmental organizations.*[172] The definition of "*damage*" emphasises a link to persons or property.[173] This limits the Liability Convention's for it to be applicable to outer space and to promote broader environmental protection.[174] A liability regime is an ineffective mechanism if the damage cannot be traced to a specific party.[175] The term "*launching State*" means: *(i) A State which launches or procures the launching of a space object; (ii) A State from whose territory or facility a space object is launched.*[176] The term "space object" *includes component parts of a space object as well as its launch vehicle and parts thereof.*[177] It is not specified whether the "*component parts*" or "*launch vehicle*" must be connected to the object.[178] It is uncertain whether this treaty is applicable to space debris because the treaty fails to define what a "*component part*" of a "*space object*" is, or whether either term includes space debris.[179] The applicability of space debris to the term "*space object*" is an ambiguity that should be resolved by providing a more extensive definition.[180] Article II states that, *"[a] launching State shall be absolutely liable to pay compensation for damage caused by its space object on the surface of the Earth*".[181] The Liability

[170] Seymour JM (1998) 900.
[171] Seymour JM (1998) 900.
[172] Article 1(a) of the Liability Convention.
[173] Roberts L (1992) 64.
[174] Roberts L (1992) 64.
[175] Roberts L (1992) 65.
[176] Article 1(c) of the Liability Convention.
[177] Article 1(d) of the Liability Convention.
[178] Seymour JM (1998) 900.
[179] Imburgia JS (2011) 616.
[180] Roberts L (1992) 64.
[181] Article II of the Liability Convention.

Convention operates under the assumption that the launching state of any given space object will be easily identifiable, however with space debris, this is not the case.[182] The Liability Convention provides too many gaps to be applicable to address space debris.[183] Article II could include legal liability for collisions between space debris; however, it is unclear if the definition of space object under the Liability Convention covers space debris.[184] Article III describes the standard of liability for activities in outer space: "*In the event of damage being caused elsewhere than on the surface of the Earth to a space object of one launching State or to persons or property on board such a space object by a space object of another launching State, the latter shall be liable only if the damage is due to its fault or the fault of persons for whom it is responsible"*.[185] Although certain activities such as deliberate explosion of a spacecraft in orbit fall within the fault provisions of Article III, it is unclear how far the provision extends.[186] Fault is difficult to determine in cases of damage caused by space debris, therefore the Liability Convention presents difficulties in addressing the problem of space debris.[187] Ownership of a particular debris is difficult to track and causation is hard to determine.[188] The Convention does not define the term "*fault*," so an owner or launching state would have difficulty determining the level of care necessary to avoid liability.[189] It is uncertain whether debris caused by a spacecraft will be traceable to the launching state, as long as this uncertainty exists states have no reason to take measures to prevent the spread of debris.[190] Even if the terms of the Liability Convention does include space debris, it does not prevent debris creation, because

[182] Imburgia JS (2011) 617.
[183] Imburgia JS (2011) 618.
[184] Hollingsworth G (2013) 257.
[185] Article III of the Liability Convention.
[186] Roberts L (1992) 64.
[187] Seymour JM (1998) 900.
[188] Seymour JM (1998) 900.
[189] Seymour JM (1998) 900.
[190] Roberts L (1992) 65.

the Liability Convention requires fault before liability can be assessed.[191] Fault is hard to prove in outer space, as space debris is not always identifiable or tractable and there is no liability when space debris unintentionally causes damage in space.[192] It is difficult to envisage how an object damaged by debris could be considered to be negligent if it were merely orbiting the Earth.[193] The Liability Convention does not enforce space-faring nations to minimise space debris or to remove debris currently in existence.[194]

Article X of the Liability Convention provides "*that a claim for compensation for damage may be presented to a launching State not later than one year following the date of the occurrence of the damage or the identification of the launching State which is liable"*.[195] In consideration of damages the Liability Convention provides that they should be paid to restore the claimant to the condition which would have existed if the damage had not occurred.[196] Should a satellite be damaged in orbit there would be uncertainty as the debris responsible would be too small to be tracked, therefore it would be impossible for liability to be proved.[197] Article XII of the Liability convention provides: "*The compensation which the launching State shall be liable to pay for damage under this Convention shall be determined in accordance with international law …, in order to provide such reparation in respect of the damage as will restore the person, … to the condition which would have existed if the damage had not occurred"*.[198] The Liability Convention, sets forth the rules for personal injury and

[191] Imburgia JS (2011) 617.
[192] Imburgia JS (2011) 617.
[193] Brearley A (2008) 309.
[194] Imburgia JS (2011) 617.
[195] Article X of the Liability Convention.
[196] Brearley A (2008) 309.
[197] Brearley A (2008) 318.
[198] Article XII of the Liability Convention.

property damage and for resolution of those issues.[199] Articles I and II of the agreement, provide that a country which launches or procures the launching of a space object, or from whose territory a space object is launched, and is liable for damage caused by its space object on the surface of the earth or to aircraft in flight.[200] Liability is not clearly established with respect to damage caused elsewhere than on the surface of the earth.[201] The Liability Convention provides compensation for damage caused by space objects.[202] The convention allows claims to be made against a launching state by natural or juridical persons. The convention does allow claims to be made by foreign countries directly against the launching state.[203] This Convention does not assist in addressing who is liable for damage that has already occurred.[204] Although the Liability Convention is not capable of imposing a duty to clean up or mitigate space debris creation, several provisions of the Liability Convention could extend liability to debris creating states.[205]

The provisions of the treaty are not easily applicable to the problem of debris.[206] First, to determine which state launched an object that has caused damage is difficult to ascertain when considering tiny debris.[207] Secondly, the Liability Convention when addressing incidents of damage in outer space requires fault to be proven, it is difficult to conceptualise how pieces of debris which are in orbit, as a by-product of space activities, could be considered to exist because of fault by states.[208] The treaty aims

[199] Mukherjee & Mokkapati 'Determining Liability for Damage Caused due to Debris in Outer Space: - Portal to a New Regime' (2009) 52 *Proceedings of the International Institute of Space Law* 287.
[200] Mukherjee & Mokkapati (2009) 287.
[201] Mukherjee & Mokkapati (2009) 287.
[202] Roberts L (1992) 63.
[203] Christol CQ (1980) 353.
[204] Schladebach M (2013) 71.
[205] Hollingsworth G (2013) 257.
[206] Brearley A (2008) 318.
[207] Brearley A (2008) 318.
[208] Brearley A (2008) 318.

to be restorative, as it addresses the situation after the damage has occurred, whereas there is a need is to reduce the possibility of incidents before they occur, rather than after the damage has occurred.[209] The Liability Convention is not the solution for mitigating the space debris problem.[210] As space debris was not identified as a problem when the treaty was drafted the treaty's principles although applicable, do not directly address the issue of space debris.[211]

3.4 THE REGISTRATION CONVENTION

Article II(1) of the Registration Convention requires a launching state to register the space object launched into space "*by means of an entry in an appropriate registry which it shall maintain*".[212] Each launching state shall "*inform the UNSG of the establishment of such a registry*."[213] Each launching state must provide the name of the state, a designation or registration number for the object, and details regarding the orbital parameters.[214] Although the Convention provides that any registering state may provide the UNSG with additional information concerning a space object carried on its registry, and must notify the UNSG when such an object is "*no longer in earth orbit*", there is no explicit tracking requirement for objects once they are in orbit.[215] Should an object become non-functional but remain in orbit, the launching state is not obligated to inform the UNSG, even if there is reason to believe that the object has been involved in a collision and has therefore suffered structural damage.[216] In terms of Article IV(1) of the Registration Convention "*Each State of registry shall furnish to the Secretary-*

[209] Brearley A (2008) 319.
[210] Hollingsworth G (2013) 257.
[211] Brearley A 2008) 315.
[212] Article II(1) of the Registration Convention
[213] Article II(1) of the Registration Convention
[214] Article IV(1) of the Registration Convention.
[215] Seymour JM (1998) 901.
[216] Seymour JM (1998) 901.

General of the United Nations, as soon as practicable".[217] The UNSG shall be notified as soon as practicable after the space launch occurs, therefore there is no fixed length of time deemed "practical" for proper notification to the UNSG. [218] The lack of timelines for UN registration is a shortcoming of the Registration Convention.[219] It provides for the possibility of collisions and malfunctioning's and their consequences, including the identification of certain kinds of harm for which damages might be recovered.[220] Failure to register a satellite presents a huge obstacle to subsequent identification of any piece of space debris from or caused by that satellite.[221] The Registration Convention does not require a launching state to provide appropriate identification markings for its spacecraft and its component parts.[222] Furthermore the Registration Convention lacks clarity as to whether only active satellites are required to be registered, or whether inactive satellites, failed missions, and space object breakup might also be required to be registered.[223] The Registration Convention does impose a duty for nations to register the space debris that they create.[224] The purpose of the Registration Convention is to give states a basis to institute liability claims for damaged objects.[225] However this is difficult because space debris is often unidentifiable.[226] Certain provisions of the Registration Convention would be applicable to the identification and mitigation of space debris.[227] The Registration Convention is important to identify a space object as well as any debris resulting from the object

[217] Article IV(1) of the Registration Convention.
[218] Imburgia JS (2011 618.
[219] Imburgia JS (2011) 618.
[220] Christol CQ (1980) 353.
[221] Imburgia JS (2011) 619.
[222] Imburgia JS (2011) 619.
[223] Imburgia JS (2011) 619.
[224] Imburgia JS (2011) 619.
[225] Hollingsworth G (2013) 258.
[226] Hollingsworth G (2013) 258.
[227] Hollingsworth G (2013) 258.

itself.[228] However the convention does not include space debris.[229] The Registration Convention does not remedy the problem of ascertaining which nation is responsible for a particular piece of space debris.[230] This registry lists information for launches but does not include any space debris or non-functioning orbital objects.[231] Therefore even if the Liability Convention applied to space debris, enforcing its provisions against the offending state would be almost impossible due to a lack of adequate recording under the Registration Convention.[232] The Registration Convention however does create a data sharing duty to assist in the tracking of space objects, but the duties under that obligation are not absolute and are likely inapplicable to space debris.[233] Article VI of the Registration Convention states: *"Where the application of the provisions of this Convention has not enabled a State Party to identify a space object which has caused damage to it or to any of its natural or juridical persons, or which may be of a hazardous or deleterious nature, other States Parties, …, shall respond to the greatest extent feasible to a request State Party, or transmitted through the Secretary-General on its behalf, for assistance under equitable and reasonable conditions in the identification of the object".*[234] The phrase "to the greatest extent feasible" raises questions of how much data must be shared.[235] The Registration Convention does not specifically address the issue of liability.[236] It does, however, facilitate compensation for damage caused by space objects by ensuring that such objects are identified as clearly as possible.[237] Articles I and IV set forth the minimum criteria necessary for identifying

[228] Schladebach M (2013) 71.
[229] Schladebach M (2013) 71.
[230] Imburgia JS (2011) 618.
[231] Hollingsworth G (2013) 258.
[232] Imburgia JS (2011) 619.
[233] Imburgia JS (2011) 619.
[234] Registration Convention article VI.
[235] Imburgia JS (2011) 620.
[236] Roberts L (1992) 63.
[237] Roberts L (1992) 63.

spacecraft and their component parts.[238] However, the Registration Convention does not entirely resolve the issues of applicability or ownership.[239]

Many launches go unregistered and unreported to the UN since the Convention does not provide a timeline for registration and reporting.[240] This makes it difficult for states to identify whose object is at fault for damage.[241] Furthermore, the Registration Convention is unclear as to whether debris may be included in the registration provisions.[242] Even if debris was included in the Convention, finding liable parties would be difficult with the amount of registration noncompliance.[243] Hence the Registration Convention does not provide for the adequate regulation of space debris.[244]

3.5 THE RESCUE AGREEMENT

The Rescue Agreement sets down specific provisions requiring states to provide assistance to astronauts in case of emergency and to return to the launching state astronauts who have made an emergency landing.[245] The Rescue Agreement, although primarily concerned with the treatment of personnel in outer space the Rescue Agreement, in Article 5, addresses objects which return from outer space.[246] Article 5 of the Rescue Agreement governs the return to the earth of space objects, and dictates that the launching authority of such an object take effective steps to eliminate possible danger of harm by it.[247] In this manner, an obligation is created on

[238] Roberts L (1992) 63.
[239] Roberts L (1992) 63.
[240] Hollingsworth G (2013) 258.
[241] Hollingsworth G (2013) 258.
[242] Hollingsworth G (2013) 258.
[243] Hollingsworth G (2013) 258.
[244] Hollingsworth G (2013) 258
[245] Wessel B (2012) 292.
[246] Brearley A (2008) 305.
[247] Seymour JM (1998) 899.

the part of the launching authority to render a space object harmless upon notification by the recovering state of the return to the earth of a space object.[248] Article 5(3) provides for the return of objects, and their component parts.[249] The treaty also provides states with a means to request assistance from the launching state, in the recovery of objects which have landed in their territory.[250] Article 5(4) deals with occasions when hazardous materials are found to have landed within the territory of a state.[251] In such circumstances, the launching state is obliged to take immediate actions in order to eliminate possible danger and the costs involved in recovering crashed space objects, are to be borne by the launching state.[252] Hence the treaty is not adequate to apply to objects that remain in outer space, since it refers to objects that return to Earth in territory under a Party's jurisdiction.[253] However, the treaty indicates that, to the extent ownership and/or responsibility for a given space object can be determined, liability for any damage caused by that object remains with its owners and launching state.[254]

3.6 THE MOON AGREEMENT

The Moon Treaty applies to the Moon and celestial bodies other than the Earth.[255] The Moon Treaty does not provide for any remedies or solutions to space debris.[256] Although the Moon Treaty does not apply directly to space debris it is useful for articulating the beginnings of an environmental standard for Earth orbit.[257] The Moon

[248] Seymour JM (1998) 900.
[249] Brearley A (2008) 306.
[250] Brearley A (2008) 306.
[251] Brearley A (2008) 306.
[252] Brearley A (2008) 306.
[253] Seymour JM (1998) 900.
[254] Seymour JM (1998) 900.
[255] Article 1 of the Moon Treaty.
[256] Hollingsworth G (2013) 259.
[257] Hollingsworth G (2013) 259.

Agreement contains provisions concerning limitations on military operations, sharing of scientific information, and non-appropriation of lunar territory.[258] The Moon Agreement provides that any exploitation of lunar resources be carried out through an international regime that would ensure all states share equitably in the benefits of those resources.[259] Article 7(1) of the Moon Agreement provides that *"In exploring and using the moon, States Parties shall take measures to prevent the disruption of the existing balance of its environment, whether by introducing adverse changes in that environment, by its harmful contamination through the introduction of extra-environmental matter or otherwise. States Parties shall also take measures to avoid harmfully affecting the environment of the earth through the introduction of extraterrestrial matter or otherwise".*[260] Unlike Article IX of the OST, Article 7 of the Moon Treaty specifically addresses the issue of environmental quality.[261] However Article 7 like Article IX of the OST is also unclear on what is "*harmful contamination*".[262]

In terms of the OST exploration and use of outer space is the province of mankind.[263] This idea is repeated and expanded in the Moon Treaty, which states that the moon and other space resources are the common heritage of mankind.[264] The Moon Agreement is contentious because it amends the legal status of the Moon and celestial bodies other than the Earth, from the '*province of all mankind*' under the OST, to the '*common heritage of mankind*'.[265] From each of these declarations flows the

[258] Wessel B (2012) 293.
[259] Wessel B (2012) 293.
[260] Article 7(1) of the Moon Agreement.
[261] Roberts L (1992) 62.
[262] Roberts L (1992) 62.
[263] Mirzaee S 'Outer Space and Common Heritage of Mankind: Challenges and Solutions' (2017) 21 *RUDN Journal of Law* 104.
[264] Mirzaee S (2017) 104.
[265] Mirzaee S 2017) 106.

proposition that benefits from outer space shall accrue to all mankind.[266] The CHM principle consists of five elements when applied to common space areas.[267] First, these regions would not be subject to appropriation, common space areas would not be owned by any state, the entire area would be administered by the international community (through treaties or norms of international law), thus ownership would be absent.[268] The main concept is access to the region, rather than ownership of it.[269] Second, under a CHM regime all people would be expected to share in the management of a common space area.[270] Third, if natural resources were exploited from a common space area, any economic benefits derived from those efforts would be shared internationally.[271] A fourth element in a CHM regime is that use of the area must be limited, to peaceful purposes.[272] Under a CHM regime, agencies engaged in profit would be deemed inappropriate, unless it is to enhance the common benefit of all mankind.[273] Lastly the research conducted will be freely and openly permissible, as long as the environment of the common space area is not physically threatened or ecologically impaired.[274] The CHM doctrine challenges the traditional notion of resource acquisition and ownership.[275] The CHM has remained vague and ill-defined as a concept in international relations, mainly to the economic, security, and political stakes at risk for states.[276] The CHM has been incorporated into the Moon Treaty. Article 11(1), of the Moon Treaty states that: "*The moon and its natural resources are*

[266] Mirzaee S (2017) 104.
[267] Joyner CC 'Legal Implications of the Concept of the Common Heritage of Mankind' (1986) 35 *The International and Comparative Law Quarterly* 191.
[268] Joyner CC (1986) 191.
[269] Joyner CC (1986) 194.
[270] Joyner CC (1986)191.
[271] Joyner CC (1986) 192.
[272] Joyner CC (1986) 192.
[273] Joyner CC (1986) 192.
[274] Joyner CC (1986) 192.
[275] Joyner CC (1999) 616.
[276] Joyner CC (1999) 616.

the common heritage of mankind."[277] The following paragraph states that: "*The moon is not subject to national appropriation by any claim of sovereignty,….*"[278] Article 11(3) says *'that neither the moon's surface nor subsurface, nor any part thereof or natural resources in place, may become the property of any State, … .*".[279] Paragraph 4 guarantees rights of non-discrimination and equal access for state parties to the use and exploration of the moon, and paragraph 5 would commit state parties "*to undertake to establish an inter-national regime, including appropriate procedures, to govern the exploitation of the natural resources of the moon as such exploitation is about to become feasible*".[280] The treaty emphasizes the conception of outer space resources as the CHM as well as the creation of a shared resource regime.[281] The essence of the CHM is conveyed in Article 4(1) "*The exploration of the moon shall be the province of all man-kind and shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development*."[282] The moon and its natural resources will be used for the benefit of all people, not just for those who possess the technological means to exploit them.[283] CHM may indicate an emergent principle of international law.[284] The CHM principle ensures developing countries participation in exploitation and management of space and seabed resources and prevent developed countries to monopolise these areas.[285] Therefore, if the concept of CHM turned into a binding principle, applying its elements will challenge all of current spatial activities and make conditions harder for space

[277] Article 11(1) of the Moon Treaty.
[278] Article 11(2) of the Moon Treaty.
[279] Article 11(3) of the Moon Treaty.
[280] Article 11(5) of the Moon Treaty.
[281] Roberts L (1992) 62.
[282] Article 4 of the Moon Treaty.
[283] Joyner CC (1986) 196.
[284] Joyner CC (1986) 199.
[285] Mirzaee S (2017) 103.

powers.[286] The Moon Agreement's CHM principle and its provisions on an international regime governing natural resources would override and contradict the substance of the OST's general provisions.[287] The general assumption under international law is that states are free to appropriate natural resources unless otherwise prohibited.[288] Thus, by not placing limits on resource appropriation, the OST tacitly allows states to exploit extra-terrestrial resources freely.[289] The reasons for the ineffectiveness of Moon Treaty is the concept of CHM.[290]

The Moon Agreement is only binding on the states that ratified it, however no major space-faring state has done so.[291] Lack of interest in the Moon Agreement may be the result of the states' reluctance to disclose information and concerns over the CHM provision.[292] The developed nations fear that adoption of the CHM principle in space exploration would tantamount to transfer of wealth, political power, and technology from the space-faring nations to developing states.[293] There are more reasons for developed countries disapproval regarding Moon Treaty first, the principles enshrined in the Moon Treaty are a departure from traditional property rights.[294] Second, the Treaty would establish guiding principles for the international regime unfavourable to the interests of private enterprise.[295] Third, the Moon Agreement provides other states political control over commercial exploitation of the moon.[296] States are reluctant to

[286] Mirzaee S (2017) 103.
[287] Wessel B (2012) 311.
[288] Wessel B (2012) 311.
[289] Wessel B (2012) 311.
[290] Mirzaee S (2017) 106.
[291] Hytrek M 'Property Rights in Current Space Law: A Hindrance to Space Exploration' (2018) 39 *Whittier Law Review* 102.
[292] Hytrek M (2018) 103.
[293] Mirzaee S (2017) 107.
[294] Mirzaee S (2017) 107.
[295] Mirzaee S (2017) 107.
[296] Mirzaee S (2017) 107.

sign the Moon Treaty because the CHM principle favours developing states and provides them with benefits that are incurred from the resources found in the areas of CHM whether or not they contribute in the efforts to retrieve the resources.[297] Some states have raised objections to this principle owing to several issues, one major issue relates to the vague interpretation of this principle and the absence of a particular mechanism for the sharing of benefits among states.[298] Hence, this treaty also does not assist with the problem of space debris due only a limited number of states who have ratified the Moon treaty.

3.7 NON-BINDING INTERNATIONAL GUIDELINES

The Inter-Agency Space Debris Coordination Committee (IADC) and the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) identified four common practices among major space-faring states: (1) limitation of debris released during normal operations; (2) minimisation of the potential for on-orbit break-ups during and after space operations; (3) post-mission disposal recommendations for vehicles in LEO, GEO and (4) prevention of on-orbit collisions.[299] From these practices the COPUOS developed seven international guidelines with the aim of developing wider acceptance among the international space community.[300] This section briefly highlights these guidelines.

[297] Qureshi WA 'Protecting the Common Heritage of Mankind beyond National Jurisdiction' (2019) 36 *Arizona Journal of International and Comparative Law* 108
[298] Qureshi WA (2019) 109.
[299] Welly ND (2010) 301.
[300] Welly ND (2010) 301.

3.7.1 THE IADC AND COPUOS GUIDELINES

The international space community has been aware of the growing space debris pollution.[301] Concerted international action to address the problem did not begin until the establishment of the IADC.[302] The IADC is an international forum of governmental bodies for the coordination of activities related to the issues of man-made and natural debris in space.[303] While there is no treaty that specifically addresses space debris, the IADC, an independent and international scientific consortium, seeks to promote the exchange of information and to encourage the remediation of existing space debris.[304] The IADC adopted a set of guidelines for space debris mitigation measures in 2002.[305] These guidelines provide the first international document addressing space debris mitigation.[306] Due to the international concerns surrounding the space debris problem, the UN General Assembly sought to formally address the issue.[307] The UN General Assembly thus established COPUOS.[308] With a view to expediting the international adoption of voluntary debris mitigation measures, the COPUOS collaborated with the IADC to update and revise the IADC guidelines on debris mitigation.[309] The guidelines were adopted and endorsed as the Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space (the guidelines).[310] The guidelines are as follows:

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[301] Chatterjee J 'Legal Issues Relating to Unauthorised Space Debris Remediation' available at http://iislweb.org/docs/Diederiks2014a.pdf (accessed 5 January 2019).
[302] Chatterjee J 'Legal Issues Relating to Unauthorised Space Debris Remediation' available at http://iislweb.org/docs/Diederiks2014a.pdf (accessed 5 January 2019).
[303] Mukherjee & Mokkapati (2009) 288.
[304] Mukherjee & Mokkapati (2009) 286.
[305] Chatterjee J 'Legal Issues Relating to Unauthorised Space Debris Remediation' available at http://iislweb.org/docs/Diederiks2014a.pdf (accessed 5 January 2019).
[306] Mukherjee & Mokkapati (2009) 288.
[307] Imburgia JS (2011) 620.
[308] Wessel B (2012) 291.
[309] Chatterjee J 'Legal Issues Relating to Unauthorised Space Debris Remediation' available at http://iislweb.org/docs/Diederiks2014a.pdf (accessed 5 January 2019).
[310] Chatterjee J 'Legal Issues Relating to Unauthorised Space Debris Remediation' available at http://iislweb.org/docs/Diederiks2014a.pdf (accessed 5 January 2019).

Guideline 1: Limit debris released during normal operations;

Guideline 2: Minimize the potential for break-ups during operational phases;

Guideline 3: Limit the probability of accidental collision in orbit;

Guideline 4: Avoid intentional destruction and other harmful activities;

Guideline 5: Minimize potential for post-mission break-ups resulting from stored energy;

Guideline 6: Limit the long-term presence of spacecraft and launch vehicle orbital stages in the LEO region after the end of their mission; and

Guideline 7: Limit the long-term interference of spacecraft and launch vehicle orbital stages with the GEO region after the end of their mission.[311]

The guidelines although not legally binding, enjoy a wide acceptance among the global space community since they are based upon the recommendations and best practices of the several space-faring states who make up the IADC.[312] The guidelines serves a basis for debris mitigation by providing a non-binding policy document and by providing applicable implementation standards.[313] In creating these non-binding guidelines, COPUOS attempted to define the term "space debris".[314] This definition included "*all man-made objects, including fragments and elements thereof, in Earth orbit or re-entering the atmosphere, that are non-functional*."[315] The guidelines require member states and international organizations to voluntarily take measures, to ensure that the guidelines are implemented.[316] These guidelines fail to address the need to remove the space debris currently in existence and the space debris that will inevitably

[311] United Nations Office for Outer Space Affairs 'Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space' available at *http://www.unoosa.org/pdf/publications/st_space_49E.pdf* (accessed 10 January 2019).
[312] Welly ND (2010) 276.
[313] Mukherjee & Mokkapati (2009) 288.
[314] Imburgia JS (2011) 624.
[315] Imburgia JS (2011) 624.
[316] Imburgia JS (2011) 625.

be created in the future.[317] COPUOS has recognised that while these measures will successfully decrease the growth rate of orbital debris, they alone do not solve the debris problem, as space debris continues to rise.[318]

3.8 CONCLUSION

Although sections of the above treaties are vaguely applicable to space debris, they are not adequate to provide a solution to the problem.[319] The above treaties are too broad and not sufficiently tailored to provide the international community with a uniform solution to address the problem of space debris.[320] There is no legal concept of 'space debris' under international space law and thus no mechanisms to regulate it.[321] The Agreements cover a wide range of issues relating to outer space, however these agreements have not effectively managed the problem of space debris.[322] No international agreement defines the term “space debris” therefore it is impossible to address a problem that is neither defined nor institutionally acknowledged. The existing treaties relevant to outer space were drafted before space debris was identified as a serious problem, therefore they are not adequate to address the problem of space debris.[323] The current space treaties are more related to the use of space and not to debris regulation.[324] The international community requires a specific treaty addressing space debris, however our current geo-political environment is not conducive for such an approach due to the competing interests and priorities of

[317] Imburgia JS (2011) 626.
[318] Welly ND (2010) 297.
[319] Hollingsworth G (2013) 259.
[320] Hollingsworth G (2013) 259.
[321] Imburgia JS (2011) 611.
[322] Roberts L (1992) 52.
[323] Roberts L (1992) 65.
[324] Mukherjee & Mokkapati (2009) 287.

different states.[325] Furthermore the guidelines are useful however they remain voluntary and are not legally binding under international law, which means that space launches can still create more debris.[326]

[325] Chatterjee J 'Legal Issues Relating to Unauthorised Space Debris Remediation' available at *http://iislweb.org/docs/Diederiks2014a.pdf* (accessed 5 January 2019).
[326] Mukherjee & Mokkapati (2009) 287.

CHAPTER 4: INTERNATIONAL ENVIRONMENTAL LAW PRINCIPLES

4.1 INTRODUCTION

The treaties relevant to outer space were concluded during a period when states were not aware of the space debris problem, and therefore the treaties are not directly linked to space debris. However international environmental law has developed important norms and principles. The question remains whether general principles of international environmental law can bridge the gaps between the outer space agreements and the protection of the outer space environment. In this chapter I will deliberate on the established international environmental norms such as Principle 21 of the Stockholm Declaration; Sustainable Development; the Common but Differentiated Responsibilities; the Precautionary Principle; and the Polluter Pays Principle.

4.2 ESTABLISHED IEL NORMS AND PRINCIPLES

International environmental law is a system of norms, and norms are general legal principles that are widely accepted.[327] This acceptance can be in several of ways, such as international agreements, national legislation, domestic and international judicial decisions, and scholarly writings.[328] Norms refer to a community standard that aims to guide or influence behaviour.[329] International instruments reflect these community standards in the form of "hard law" or "soft law."[330] Hard law has legally binding force and includes instruments such as treaties/conventions and customs.[331] Conventions

[327] Rani YP 'International Space Law Regime and Protection of Environment: Emerging Issues' in Singh, Kaul & Rao (ed) *Current Developments in Air and Space Law* (2012) 318.
[328] Rani YP (2012) 318.
[329] Lee J 'Rooting the Concept of Common but Differentiated Responsibilities in Established Principles of International Environmental Law' (2015) 17 *Vermont Journal of Environmental Law* 39.
[330] Lee J (2015 39.
[331] Lee J (2015) 39.

and customary law are the primary sources of international environmental law. "Soft law" refers to non-binding international instruments such as resolutions, declarations, statements, principles, objectives, and guidelines.[332] Soft law performs an important gap-filling function where hard law fails to extend.[333] Principles are often used to interpret hard law instruments.[334] Sometimes, treaties list principles to guide its interpretation.[335] Some established norms of international environmental law may be extended to the outer space environment as well, with appropriate modifications where necessary.[336] The leading norms and principles of international environmental law are addressed below.

4.3 PRINCIPLE 21 et seq

The UN Conference on the Human Environment, convened in Stockholm in 1972 was the first major international gathering that considered global environmental concerns. Its important outcome was the 1972 Stockholm Declaration of the UN conference on the Human Environment (Stockholm Declaration) which sets out 26 principles, the most known being Principle 21. In terms of Principle 21 *"States have the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction*".[337] This "soft law" principle is considered to be a basic norm of customary international environmental law. After the Stockholm Declaration, the 1992 UN

[332] Lee J (2015) 39.
[333] Lee J (2015) 39.
[334] Lee J (2015) 39.
[335] Lee J (2015) 39.
[336] Rani YP (2012) 318.
[337] 'Report of the United Nations Conference on the Human Environment' available at https://www.un.org/ga/search/view_doc.asp?symbol=A/CONF.48/14/REV.1 (accessed 13 October 2019).

Conference on Environment and Development was convened in Rio de Janeiro, this saw the adoption of the 1992 UN Framework Convention on Climate Change (the UNFCCC).[338] It also adopted the Declaration on Environment and Development (the Rio Declaration) as well as Agenda 21, an action programme. The Rio Declaration comprises of 27 principles based on the foundation of sustainable development. Principle 21 of the Stockholm Declaration is reaffirmed in Principle 2 of the Rio Declaration, which provides as follows: "*States have, … , the sovereign right to exploit their own resources pursuant to their own environmental and developmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction*".[339] These two principles provide that the states have responsibility to ensure activities within their jurisdiction or control do not damage the environment of other states or of *areas beyond the limits of their national jurisdiction.*[340] Many of these principles has been established in international case law. The *Trail Smelter Arbitration* (*US v Canada*)[341] concerned a dispute between the USA and Canada arising from damage allegedly caused to wheat crops on farms in the USA near the Canadian border by fumes generated by an iron smelter in Canadian territory. In finding in favour of the USA, the Tribunal held that: *Under principles of international law, . . . no State has the right to use or permit the use of its territory in such a manner as to cause injury by fumes in or to the territory of another or the properties or the persons therein, when the cause is of serious consequence and the injury is*

[338] 'United Nations Framework Convention on Climate Change' available at https://unfccc.int/resource/docs/convkp/conveng.pdf (accessed 14 October 2019).
[339] 'The Rio Declaration on Environment and Development' (1992) available at http://www.unesco.org/education/pdf/RIO_E.PDF (accessed 19 September 2019).
[340] Uchitomi M 'Sustainable Development in Outer Space-Applicability of the Concept of Sustainable Development to Space Debris Problems' (2000) 43 *Proceedings on the Law of Outer Space* 74.
[341] 33 AJIL [1939] 182 and 35 AJIL [1941] 684 respectively (cited hereafter as the *Trail Smelter*).

established by clear and convincing evidence.[342] This *dictum* is an important milestone in the development of the international law of state responsibility in the context of environmental concerns, and was reaffirmed in Principle 21 of the 1972 Stockholm Declaration. In the *Trail Smelter* the Court of Arbitration held that a state must protect other states from injury caused by the acts of those within its control.[343]

The *Corfu Channel Case* (*United Kingdom v Albania*)[344] related to the United Kingdom sending a number of cruisers through the North Corfu Channel in 1946, relying on the right of innocent passage in international law. Albania fired on the vessels. The Court held Albania responsible for damage to British warships caused by a failure to warn them of mines in territorial waters. The International Court of Justice held that there is an obligation of every state "not to allow knowingly its territory to be used for acts contrary to the rights of other states."[345] The same principle was of relevance in the *Trail Smelter* arbitration coupled with the duty to pay monetary damages for identified harm to property.[346] The case serves as a customary law authority for an obligation to give warning of known environmental hazards. The general obligation of states not to damage the environment beyond national jurisdictions was established in *Trail Smelter Arbitrations* and enshrined in Principle 21 of the Stockholm Declaration and Principle 2 of the Rio Declaration.[347]

Although environmental law regulates environment protection on the Earth, these provisions appear to cover protection of the outer space environment as well because outer space corresponds to "an area beyond the limits of national jurisdiction". The

[342] United Nations Reports of International Awards *Trail Smelter Arbitration (US v Canada)* (1938 and 1941) 3 RIAA 1905 at 1908.
[343] Roberts L (1992) 65.
[344] International Court of Justice Reports [1949] 22.
[345] Christol CQ (1980) 353.
[346] Christol CQ (1980) 353.
[347] Uchitomi M (2000 74.

Trail Smelter case, only makes a limited contribution to a theory of international liability for space debris.[348] The Stockholm Declaration, was drafted subsequent to the OST and Article III of the Liability Convention. Principle 21 “no harm” can extend to the prevention of outer space pollution.[349] The use of the phrase 'jurisdiction and control’, a term of found in Article VIII of the OST, makes it difficult to imagine that Principle 21 would not apply to the space environment as well as to more terrestrial domains.[350] These principles however do not offer clear legal guidance to deal with space debris.[351]

4.4. SUSTAINABLE DEVELOPMENT

Sustainable development first appeared in the Stockholm Declaration.[352] Principle I of the Stockholm Declaration states that nations have a "*solemn responsibility to protect and improve the environment for present and future generations”*.[353] The term ‘sustainable development’ was created in the Brundlandt Report and defined as ‘*meeting the needs and aspirations of the present without compromising the ability to meet those of the future’*.[354] Sustainable development has been developed to apply to common areas.[355] The Rio Declaration established a further commitment to protect the Earth's natural environmental resources and implement the goals of sustainable development.[356] Principle 7 of the Rio declaration provides that: “*States shall co-*

[348] Roberts L (1992) 66.
[349] Schladebach M (2013) 73.
[350] Roberts L (1992) 66.
[351] Schladebach M (2013) 73.
[352] Bird RC ‘Procedural Challenges to Environmental Regulation of Space Debris’ (2003) 40 *American Business Law Journal* 659.
[353] ‘United Nations Framework Convention on Climate Change’ available at https://unfccc.int/resource/docs/convkp/conveng.pdf (accessed on 14 October 2019).
[354] ‘Report of the World Commission on Environment and Development: Our Common Future’ available at https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf (accessed 29 October 2019).
[355] Bird RC (2003) 660.
[356] Bird RC (2003) 660.

operate in a spirit of global partnership to conserve, protect and restore the health and integrity of the Earth's ecosystem. … States have common but differentiated responsibilities. The developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command".[357] Sustainable development is a leitmotif of international environmental law and principles. Sustainable development aims to create a balance between present and future use and to conciliate the promotion of economic development and the protection of the environment.[358] Firstly, the environment is a resource to be used for promoting economic development of current nations, particularly the less developed ones.[359] Secondly, the environment and its resources must be utilised in a way as to preserve their use for future generations.[360]

The concept of sustainable development provides guidance for the development of further treaty law and the interpretation of legal norms.[361] The principle of sustainable development is relevant to outer space. Many satellite manufacturers try to avoid intentional generation of space debris because debris might remain in the area of the satellite, thereby posing a threat to the satellite and future space activities.[362] The UN outer space treaties does make reference to sustainable development by referring to notions such as 'equitable use' and 'benefit of all countries'. Article IX of the Outer Space Treaty imposes a general duty to avoid harmful contamination of outer space.[363] The Moon Treaty makes reference to "present and future generations" as

[357] 'The Rio Declaration on Environment and Development' available at http://www.unesco.org/education/pdf/RIO_E.PDF (accessed 19 September 2019).
[358] Stubbe P 'Common but Differentiated Responsibilities for Space Debris – New Impetus for a Legal Appraisal of Outer Space Pollution' (2010) 31 *European Space Policy Institute Perspectives* 5.
[359] Viikari L (2008) 133.
[360] Viikari L (2008) 133.
[361] Stubbe P (2010) 9.
[362] Viikari L (2008) 145.
[363] Viikari L (2008) 145.

well as "economic and social development" (Article 4.1), environmental protection (Article 7) and management of natural resources (Article 11). Considerations of intra- and inter-generational equity, can also be a factor to increase environmental concern in space activities.[364] *Intra*-generational equity is equity within the present community of states and people, by guaranteeing the same opportunities to all states, even if some of these opportunities can only be realised at a later stage.[365] This is relevant in the space sector, because exploration and exploitation of outer space varies according to the capacities of states.[366] Those who do not possess space technologies want to reserve their rights and safeguard their opportunities to utilise outer space.[367] Degradation of outer space infringes on equity and the interests of other states by diminishing the possibility to use outer space.[368] Equity may require assistance from developed countries to developing countries to enable the latter to pursue sustainable development by both realising their potential rights in outer space and protecting that environment.[369] Such assistance can be, financial aid, transfer of technology, and cooperation through international organisations.[370] According to Viñuales 'Sustainable development' was successful in managing the political collision between 'development' and 'environment'.[371] It was a formidable tool to find balance as well as for normative development, however it was not adequately implemented.[372] 'Sustainable development' proved to be superior in accommodating developmental concerns, however it did not resolve the environment-development equation.[373] Economic

[364] Viikari L (2008) 145.
[365] Viikari L (2008) 145.
[366] Viikari L (2008) 145.
[367] Viikari L (2008) 146.
[368] Viikari L (2008) 146.
[369] Viikari L (2008) 146.
[370] Viikari L (2008) 146.
[371] Vinuales JE 'The Rise and Fall of Sustainable Development' (2013) 22 *Review of European, Comparative & International Environmental Law* 4.
[372] Vinuales JE (2013). 4.
[373] Vinuales JE (2013) 4.

development, social development and environmental protection are interdependent and mutually reinforcing components of sustainable development.[374] Despite its normative pull, the concept of 'sustainable development' does not provide an answer to the conflicts opposing the two terms of the environment-development equation.[375] Current space activities may represent an over-utilisation of a common resource.[376] Congestion of orbits by functional space objects may render meaningless the future plans of states that can only engage in their fair share of these activities later.[377] Developing States will never be able to exercise their right to utilise outer space unless the space environment is preserved.[378] The space industry's main concern has been the threat of deterioration of outer space to an extent which prevents utilisation.[379] The increase in space debris is as a result of an imbalance between the right to development or freedom to use and explore; and the right to and obligation of conservation of a natural resource.[380] The utilisation of outer space has turned from benefitting humankind to burdening present and future generations, space debris being a result of utilising a limited common resource.[381] States must protect the space environment in a way that ensures long-term sustainability.[382]

Sustainable development can be applied to the issue of space debris; however, the concept of sustainable development is not being effectively implemented. Sustainable

[374] United Nations General Assembly 'Programme for the Further Implementation of Agenda 21' available at https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/S-19/2&Lang=E (accessed 14 October 2019).
[375] Vinuales JE (2013) 6.
[376] Mey JH 'Space Debris Remediation' (2012) 61 *Zeitschrift fur Luft- und Weltraumrecht - German Journal of Air and Space Law* 257.
[377] Viikari L (2008) 147.
[378] Viikari L (2008) 147.
[379] Viikari L (2008) 149.
[380] Mey JH (2012) 258.
[381] Mey JH (2012) 261.
[382] Mey JH (2012) 258.

development should be incorporated in a space debris regime, but it alone is not sufficient to prevent space debris.[383]

4.5 COMMON BUT DIFFERENTIATED RESPONSIBILITIES ("CBDR")

Principle 7 of the Rio Declaration provides that: "*States shall co-operate in a spirit of global partnership to conserve, protect and restore the health and integrity of the Earth's ecosystem. In view of the different contributions to global environmental degradation, States have common but differentiated responsibilities*. *The developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command".* [384] The CBDR principle forms part of the sustainable development concept.[385] This principle ensures developing countries participate in the exploitation and management of outer space and prevents developed countries to monopoly on these areas.[386] Furthermore Article 3.1 of the UNFCCC also provides for CBDR, and states that: "*[t]he Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities". Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof".*[387] The concept of "*common but differentiated responsibilities*" is gaining acceptance.[388] "Common" suggests that certain risks affect and are affected

[383] Bird RC (2003) 661.
[384] Principle 7 of the Rio Declaration.
[385] Stubbe P (2010) 5.
[386] Mirzaee S (2017) 103.
[387] 'United Nations Framework Convention on Climate Change' available at https://unfccc.int/resource/docs/convkp/conveng.pdf (accessed 14 October 2019).
[388] Stone CD 'Common but Differentiated Responsibilities in International Law' (2004) 98 *The American Journal of International Law* 276.

by all states, these include all risk-related global public goods.[389] In reducing the mutual risks, all states should "cooperate in a spirit of global partnership."[390] Responsibilities are said to be "differentiated" in that not all states should contribute equally.[391] CBDR charges some nations, ordinarily the Rich (developed), with carrying a greater share of the burden than others, ordinarily the Poor (developing).[392] Differentiation treatment can be as follows: an agreement can make differential substantive requirements; subject some parties to a more favourable compliance timetable; permit special defences; make noncompliance, if not forgiven, overlooked; or grant qualified states financial and technical contributions.[393] This obliges developed countries to take stricter measures than developing countries. The principle of CBDR builds on the common responsibility of all states to protect the environment but recognises the differences in their ability to do so.[394] The practice of differentiating responsibilities has not been elevated to the status of a customary principle of international law.[395]

The CBDR principle is relevant to the problem of space debris.[396] CBDR principle recognises that environmental degradation mostly originates in developed countries and therefore they should bear the burden in combating the negative effects of pollution, as these countries generally possess greater capacities to respond to environmental degradation.[397] CBDR recognises that the standards applied to developing countries cannot be the same as those for developed countries, therefore

[389] Stone CD (2004) 277.
[390] Stone CD (2004) 277.
[391] Stone CD (2004) 277.
[392] Stone CD (2004) 277.
[393] Stone CD (2004) 278.
[394] Viikari L (2008) 178.
[395] Stone CD (2004) 299.
[396] Stubbe P (2010) 9.
[397] Viikari L (2008) 178.

the standards for developing countries are less demanding.[398] In assessing the application of differentiated standards, one should consider fairness and equity as well as the actual ability of an actor to prevent, control and reduce environmental harm.[399] Developed countries have contributed more to space debris than developing countries and economically profited from the exploitation of the environment.[400] Different standards for environmental protection could be applied, first, by stronger commitments of industrialised states to alleviate the problem, also in view of their higher technological and financial capabilities.[401] Apart from setting higher or lower standards, a further possibility to implement the principle can be attained by enhancing cooperation by transferring financial means or technology to developing countries.[402] With reference to the CBDR principle, some states demanded that the primary responsibility of long-standing space faring states for creating the debris population should be taken into account when seeking solutions for the problem and that such solutions shall not hamper developing states' efforts to utilise outer space.[403] Developed countries have stronger immediate needs to develop their space activities which is likely to contribute further to space debris whereas developing countries often insist on protecting the space environment in order to guarantee their possibilities for space activities in the future.[404] The spacefaring nations are concerned about degradation of the space environment although this may be due to the threats to their own space activities.[405] The CBDR principle stressed the fact that responsibility for the current degree of debris pollution is not equally distributed among states.[406] The

[398] Viikari L (2008) 178.
[399] Viikari L (2008) 178.
[400] Stubbe P (2010) 9.
[401] Stubbe P (2010) 9.
[402] Stubbe P (2010) 9.
[403] Stubbe P (2010) 2.
[404] Viikari L (2008) 182.
[405] Viikari L (2008) 182.
[406] Stubbe P (2010) 4.

mitigation of the space debris problem can be resolved upon differentiated responsibilities. Non-spacefaring states demand that those who have caused the current environmental degradation of the space environment should take the lead to improve the situation. There will be different responsibilities to at least some extent between developed and developing countries, it is only the spacefaring nations who can actually take effective measures to solve the problem of space pollution.[407] Differentiation is expected to bridge the gap between the formal equality of states under international law and the deep inequalities in wealth, power and responsibility that divide them.[408]

4.5.1 COMMON BUT DIFFERENTIATED RESPONSIBILITIES AND RESPECTIVE CAPABILITIES (CBDR&RC) – PARIS AGREEMENT

The Parties to the UNFCCC decided to 'launch a process to develop a protocol, another legal instrument or an agreed outcome with legal force under the Convention applicable to all Parties, after negotiations, the Paris Agreement was adopted.[409] The phrase *'applicable to all'* indicated the need to increase the collective level of ambition and ensure the highest possible mitigation efforts by all parties.[410] 'Bifurcated' or 'binary' differentiation, however, proved to be a contentious issue in the negotiations for the Paris Agreement.[411] On the one hand, there was a general understanding that the immense climate challenges can be tackled only by global, cooperative large-scale remedial action.[412] On the other hand, the responsibilities of states, their development

[407] Viikari L (2008) 183.
[408] Voigt & Ferreira 'Dynamic Differentiation: The Principles of CBDR-RC, Progression and Highest Possible Ambition in the Paris Agreement' (2016) 5 *Transnational Environmental Law* 286.
[409] United Nations Conference of the Parties 'Report of the Conference of the Parties on its twenty-first session, held in Paris from 30 November to 13 December 2015' available at *https://unfccc.int/resource/docs/2015/cop21/eng/10a01.pdf* (accessed 28 October 2019).
[410] Voigt & Ferreira (2016) 291.
[411] Voigt & Ferreira (2016) 291.
[412] Voigt & Ferreira (2016) 291.

stages and factual circumstances differ considerably.[413] The Paris Agreement strikes a balance between raising ambition and ensuring universal participation on the one hand, and equitable differentiation on the other.[414] The Paris Agreement does not differentiate between developed and developing countries, but it is still based on the principle of common but differentiated responsibilities and respective capabilities (CBDR&RC).[415] By the addition of the term 'respective capabilities', the approach to differentiation under the Paris Agreement is more diversified than under the UNFCCC, as the Paris Agreement aims to reflect the responsibilities, capacities, and circumstances of all parties.[416] Article 2.2 of the Paris Agreement provides that "*This Agreement will be implemented to reflect equity and the principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances*".[417] The qualifier 'in the light of different national circumstances' introduces a dynamic and flexible element to interpreting both responsibilities and capabilities, broadening the parameters for differentiation.[418] It allows for a more complex approach, taking into account a wider array of criteria, such as past and current, as well as projected, future emissions, and also financial and technical capabilities, human capacity, population size and other demographic criteria, abatement costs, opportunity costs, skills, etc.[419] Differentiation under the Paris Agreement has the potential to function as a catalyst for a race to the top on climate action, rather than merely a burden-sharing concept.[420] It can be said that the Paris

[413] Voigt & Ferreira (2016) 291.
[414] Voigt & Ferreira (2016) 291.
[415] Paris Agreement Article 2.
[416] Voigt & Ferreira (2016) 294.
[417] United Nations Conference of the Parties 'Report of the Conference of the Parties on its twenty-first session, held in Paris from 30 November to 13 December 2015' available at https://unfccc.int/resource/docs/2015/cop21/eng/10a01.pdf (accessed 28 October 2019).
[418] Voigt & Ferreira (2016) 294.
[419] Voigt & Ferreira (2016) 294.
[420] Voigt & Ferreira (2016) 303.

Agreement has succeeded in using differentiation as a means for enhancing ambition, as opposed to stalemating it.[421] Differentiation could become a tool for bringing countries together rather than setting countries apart, in serving the purpose of the Paris Agreement.[422]

The CBDR&RC in the Paris Agreement is dynamic and flexible and applicable to climate change however it may be useful to outer space.

4.6 THE PRECAUTIONARY PRINCIPLE

Principle 15 of the Rio Declaration provides as follows: *"In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation*".[423] A norm of international environment law is the precautionary principle. This is a duty to foresee and assess environmental risks, to warn potential victims of such risks and to behave in ways that prevent or mitigate such risks.[424] The doctrine of the precautionary principle and the related concept of sustainable development attempt to address the interests of future generations.[425] The precautionary principle, has received support to be regarded as a general principle of law and it seems quite reasonable to support its applicability to the current space debris situation.[426] The precautionary principle has become a popular method for implementing the notion of sustainable development by placing upon the

[421] Voigt & Ferreira (2016) 303.
[422] Voigt & Ferreira (2016) 303.
[423] 'The Rio Declaration on Environment and Development' available at http://www.unesco.org/education/pdf/RIO_E.PDF (accessed 14 October 2019).
[424] Rani YP (2012) 318.
[425] Roberts L (1992) 72.
[426] de O. Bittencourt Neto O 'Preserving the Outer Space Environment: The Precautionary Principle Approach to Space Debris' (2013) 56 *Proceedings of the International Institute of Space Law* 350.

prospective developer the burden of demonstrating that a particular activity would not be harmful to the environment.[427] The hazard that space debris poses in the outer space environment, though uncertain, can be estimated.[428] Damage to space assets can be identified, the effects of space debris will be felt in the future.[429] Since only non-binding international instruments offered measures to limit the production of space debris, arguably space faring nations still hold the prerogative to deal with this situation based only on their own, personal perspectives, whenever required by circumstances.[430] The precautionary principle seeks the protection of the environment from specific human activities involving grave risks, even when scientific knowledge on that regard may seem insufficient to fully comprehend the particularities of the resulting threat to nature.[431] The premise of precautionary decision making, or the "precautionary principle," is that environmental threats are so enormous and difficult to comprehend that it is necessary to establish an environmental management regime to regulate suspect activities before they cause harm.[432] The precautionary principle is a particularly controversial theory because it instructs states to make environmentally protective decisions before the potentially harmful effects of a given behaviour are proven.[433] A regime premised on the precautionary principle places the burden of proving the harmlessness of a given behaviour on the party who would engage in that behaviour.[434] In accordance with the precautionary principle, Launching States shall endure cost effective measures to contain the growing production of space

[427] Roberts L (1992) 72.
[428] Roberts L (1992) 73.
[429] Roberts L (1992) 73.
[430] de O. Bittencourt Neto O (2013) 345.
[431] de O. Bittencourt Neto O (2013) 346.
[432] Weintraub BA 'Science, International Environmental Regulation, and the Precautionary Principle: Setting Standards and Defining Terms' (1992) 1 *New York University Environmental Law Journal* 178.
[433] Weintraub BA (1992) 178.
[434] Weintraub BA (1992) 178.

debris, for protection of the outer space environment.[435] Alternatives must be considered not only by space-faring nations, but by the international community as a whole, since, in accordance with the precautionary principle, the mitigation of space debris represents a legal obligation, as far as International Law is concerned.[436] Through proper reference to a precautionary approach, it may be possible to effectively protect the outer space environment from the dangers of space debris, and to assure the viability of space activities for generations to come.[437] The precautionary principle and the polluter-pays-principle cannot, and are also not intended, to offer clear legal arguments or rules to deal with the avoidance of space debris.[438] Although precaution theoretically applies to the space debris problem, and is a useful principle for mitigating space debris, it could be difficult to reach consensus among States to adopt it as a principle to solve space debris because it directly leads to the limitation of space activities.[439] An important factor of the precaution approach is to shift the burden of proof from the person/state wishing to stop an activity onto the person/state wishing carry out that activity to show that it will not cause harm.[440] It is difficult for third-party countries, especially developing countries, to prove a harmful result of some country's space activities because of a lack of information.[441]

4.7 THE POLLUTER PAYS PRINCIPLE

Principle 16 of the Rio Declaration provides as follows: "*National authorities should endeavour to promote the internalization of environmental costs and the use of*

[435] de O. Bittencourt Neto O (2013) 350.
[436] de O. Bittencourt Neto O (2013) 351.
[437] de O. Bittencourt Neto O (2013) 351.
[438] Schladebach M (2013) 74.
[439] Uchitomi M (2000) 77.
[440] Uchitomi M (2000) 77.
[441] Uchitomi M (2000) 77.

economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment".[442] The polluter pays principle means polluters should internalise the costs of their pollution, control it, and pay for its consequences, including remedial or clean-up costs, rather than imposing other states or future generations to bear such costs.[443] It is customary international law that states can be held responsible for pollution damage caused to other states.[444] Space debris may be viewed as pollution of outer space.[445] The principle may apply not only to prevent the polluter from engaging in pollution of outer space but also to cause the polluter to compensate for the damage.[446] A possible remedy for the space debris problem would be to require the owners of satellites and launch vehicles to post bonds to insure against possible pollution.[447] Such bonds would be available to compensate victims of collisions and for the removal of debris caused by the collision.[448] It is difficult to reach a consensus on applying this principle to the space debris problem.[449] Developed countries oppose introducing this principle to the space debris problems because it raises the cost of space activities and thus limits the development of the space industry.[450] Another reason for the negative position of developed countries will be that they have not established sufficient technology for eradicating space debris.[451] In contrast, developing countries insist that space-faring countries should bear these

[442] 'The Rio Declaration on Environment and Development' available at http://www.unesco.org/education/pdf/RIO_E.PDF (accessed 19 September 2019).
[443] Rani YP (2012) 318.
[444] Larsen PB (2018) 490.
[445] Larsen PB (2018) 490.
[446] Larsen PB (2018) 491.
[447] Larsen PB (2018) 485.
[448] Larsen PB (2018) 486.
[449] Uchitomi M (2000) 77.
[450] Uchitomi M (2000) 77.
[451] Uchitomi M (2000) 77.

costs.[452] Some have even proposed that space-faring states share joint liability for the damage caused by space debris or establishing funds for such damage, since it is very difficult to prove which state caused what space debris.[453]

4.8 CONCLUSION

The question remains whether general principles of international environmental law can bridge the gaps between the Outer Space Agreements and the protection of the space environment.[454] The IEL principles appear to be applicable to the space debris problems, however these principles provide limited guidance.[455] While environmental law principles will be relevant to protecting the environment of outer space, they are not adequately implemented by states.[456] Furthermore these principles may be useful to combat space debris, however it is important to ensure that they are applied appropriately.

[452] Uchitomi M (2000) 78.
[453] Uchitomi M (2000) 78.
[454] Roberts L (1992) 65.
[455] Roberts L (1992) 65.
[456] Uchitomi M (2000) 80.

CHAPTER 5 - BRICS AS EMERGING SPACE FARING NATIONS

5.1 INTRODUCTION

Even though space activities are hazardous and costly, countries are willing to invest in this sector.[457] This is due to the potential benefits from the use of outer space.[458] As a political cooperation mechanism, BRICS has gone beyond being an acronym to emerge as a force for advancing the countries' joint interests, promoting multi-polarity and coordinating responses to key global challenges.[459] The opening of the BRICS and their increasing global influence has fuelled a growing demand within each country for new laws and administrative apparatus to govern this new economic activity and to interface with the broader economic and political environment.[460] This chapter will attempt to analyse BRICS as emerging space faring nations as well as their contribution and mitigation towards space debris.

5.2 BRAZIL

Brazil proceeded with feasibility studies for its own spacecraft in 1974, and in 1985 finally launched its first satellites.[461] Brazil has an increasingly important and sophisticated aerospace industry and has engaged in space research through its National Institute of Space Research.[462]

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[457] Viikari L (2008) 22.
[458] Viikari L (2008) 22.
[459] Wilkins & Papa 'The Rise of the Corporate Legal Elite in the BRICS: Implications for Global Governance' (2013) 36 *Boston College International and Comparative Law Review* 1150.
[460] Wilkins & Papa (2013) 1150.
[461] Ospina S 'The Third World Countries' Challenges and Contributions to Space Law' (1988) 31 *Proceedings on the Law of Outer Space* 136.
[462] Ospina S (1988) 136.

5.3 RUSSIA

Russia in large measure took over the former Soviet Union's place in the global community, this includes the major share of Soviet space activities.[463] Russia undertook a series of four launches in 2013 and 2014 that delivered manoeuvrable spacecraft into orbit, conducting covert "rendezvous and proximity operations", testing the ability to execute deft approaches to other orbiters and employing a robotic arm.[464] In 2016 Russia conducted non-destructive interception tests in space.[465]

5.4 INDIA

In 1962 India was engaging in space research.[466] By 1965 India had established a Centre for Training and Research in Satellite Communication for Developing Countries.[467] The practical application of India's space related research came about with the Satellite Instructional Television Experiment (SITE) which used one of The National Aeronautics and Space Administration (NASA)'s Applications Technology Satellites, and by 1968 INSITE was operational.[468] The Indian space/satellite communication research has aimed toward bringing to India an indigenous satellite system, geared to the country's needs.[469]

5.5 CHINA

China, is one of the major space powers, and supports activities involving peaceful use of outer space and maintains that international space cooperation should be

[463] Von der Dunk FG 'Two New National Space Laws: Russia and South Africa' (1995) 47 *Proceedings of the Forty-Eighth Colloquium on the Law of Outer Space* 251.
[464] Koplow DA (2018) 342.
[465] Koplow DA (2018) 342.
[466] Ospina S (1988) 135.
[467] Ospina S (1988) 135.
[468] Ospina S (1988) 135.
[469] Ospina S (1988) 135.

promoted and strengthened on the basis of equality, mutual benefit, and common development.[470] China has signed many inter-governmental or inter-agency cooperative agreements, protocols or memorandums, and established long term co-operative relations with many states.[471] China has executed extensive cooperation arrangements with other countries that include sharing satellite technology.[472] In 1986 China and Brazil has cooperated to form the China-Brazil Earth Resource Satellite, followed by the signature of the Protocol on Research and Production of Earth Resource Satellite in 1988.[473] China has adopted a new Department Regulation called the Interim Instrument of Space Debris Mitigation and Management in January 2010.[474] This instrument is intended to protect the space environment and to implement international obligation to control and mitigate space debris, particularly the IADC Guidelines.[475] In 2010, 2013, and 2014, China conducted delicate manoeuvres involving multiple satellite close approaches and a robotic arm, activities with both benign and weapons applications.[476] China has also indicated that it will expand its regional Beidou navigational system into the global Compass navigation system by 2020.[477]

5.6 SOUTH AFRICA

South Africa developed and launched its first satellite, The Stellenbosch University Satellite (SUNSAT), in 1999 with wholly indigenous space engineering technology

[470] Zhao Y 'Evaluation of Space Cooperation between China and Brazil: An Excellent Example of South-South Co-Operation' (2004) 47 *Proceedings on the Law of Outer Space* 216.
[471] Zhao Y (2004) 216.
[472] Zhao Y (2004) 215.
[473] Zhao Y (2004) 215.
[474] Tronchetti F 'The Problem of Space Debris: What Can Lawyers Do about It' (2015) 64 *Zeitschrift fur Luft- und Weltraumrecht German Journal of Air and Space Law* 341.
[475] Tronchetti F (2015) 341.
[476] Koplow DA (2018) 334.
[477] Koroma AG (2011). 12.

provided by students at Stellenbosch University in South Africa.[478] The SUNSAT is designed for scientific experimental purposes and it has capacity for imaging, communications, and to facilitate research and studies of the earth's atmosphere.[479] It has been used for remote sensing applications for agriculture, resources management, disaster mitigation, meteorological, and environmental purposes.[480] SUNSAT was launched as a secondary payload on an American Delta II launch vehicle.[481] SUNSAT operated in orbit until January 2001, after which there were no further launches of South African satellites until September 2009.[482] In 2003, the South African Department of Science and Technology began to appreciate the societal benefits of space applications and the role of space science and technology as a motor for technological and industrial development.[483] The Department began to play an active role in coordinating space activities in the country and started to develop a national space science and technology strategy.[484] South African National Space Agency (SANSA) and the Department is responsible for the authorisation and supervision of space activities.[485] South Africa is further developing the SumbandilaSat satellite, which will also have capacity for imaging any area in Southern Africa and for the conduct of experimental and scientific research and studies.[486] South Africa's space programme is advanced owing mainly to its capacity in space astronomy and satellite technology.[487] South Africa is one of the few African

[478] Gbem AA 'Space Developments in African Countries: An Overview' (2009) 34 *Annals of Air and Space Law*) 884.
[479] Gbem AA (2009) 884.
[480] Gbem AA (2009) 884.
[481] Martinez P 'The Development of Space Law in South Africa' (2015) 64 *Zeitschrift fur Luft- und Weltraumrecht - German Journal of Air and Space Law* 355.
[482] Martinez P (2015) 357.
[483] Martinez P (2015) 357.
[484] Martinez P (2015) 358.
[485] Martinez P (2015) 360.
[486] Gbem AA (2009) 884.
[487] Gbem AA (2009) 884.

countries that have put in place a clearly defined national space programme, a space policy and legislation as well as a national space institution.[488] South Africa has been a member state of COPUOS since 1994.[489] The country participates annually in the sessions of COPUOS and its two subcommittees.[490] South Africa also participated in the informal consultations arranged by the European Union in 2013 and 2014 to discuss the development of an International Code of Conduct for Outer Space Activities.[491] In this way the country is participating in the progressive development and codification of new norms of behaviour for the activities of States in Outer Space.[492] South Africa has a variety of institutions that play a significant role in the scientific study, exploration and utilisation of space.[493] The socio-economic benefit of space science and technology applications is the current policy driver for the development of South Africa's indigenous space programme.[494] South Africa has ratified the OST and has therefore obligated itself to ensure that its activities in outer space will be for peaceful purposes only.[495] South Africa, has committed to promote improved co-operation with other nations in the mutually beneficial peaceful uses of outer space.[496] The space debate was escalated when the government realised the value of science and technology as an engine for socio-economic growth.[497] Outer space was recognised as one of five grand challenges that the country would pursue in transitioning to a knowledge-based economy.[498]

[488] Gbem AA (2009) 884.
[489] Martinez P (2015) 358.
[490] Martinez P (2015) 358.
[491] Martinez P (2015) 358.
[492] Martinez P (2015) 358.
[493] Munsami V 'South Africa's national space policy: The dawn of a new space era' (2014) 30 *Space Policy* 116.
[494] Munsami V (2014) 117.
[495] Munsami V (2014) 119.
[496] Munsami V (2014) 119.
[497] Munsami V (2014) 120.
[498] Munsami V (2014) 120.

5.7 BRICS AS EMERGING SPACE FARING NATIONS

The BRICS countries are emerging economies, and face challenges on several similar fronts such as education, healthcare, disaster management, trade, investment.[499] Emerging markets including India and Brazil, there has been a rise on the reliance on global space systems for commerce, economic development, disaster monitoring, navigation, communication and other civilian services.[500] Since several of these services are prominent in daily life, it serves to make a case for self-reliance in emerging space nations for development of these systems and delivery mechanisms.[501] All the BRICS countries has established their own space agencies namely, Brazilian Space Agency, The Roscosmos State Corporation for Space Activities, Indian Space Research Organisation, China Manned Space Agency and South African National Space Agency. BRICS are considered developing countries and emerging space faring nations. China is one of the major space powers and has been a participant in international agreements for promotion, cooperation, mutual benefit and mutual complementarity since the mid-1970s.[502] Since the mid-80s, China has signed numerous intergovernmental as well as inter-agency agreements and has in the process, established cooperative relationships.[503] The BRICS countries ratified the OST, The Liability Convention, The Registration Convention and the Rescue Agreement, however only India is a signatory to the Moon Agreement.[504] The "Big Three" spacefaring Nations: the United States of America, Russia, and China failures

[499] Nagendra NP 'Indo-Brazil remote sensing agreement: Policy perspectives and implications for India' (2016) 49 *Space Policy* 1.
[500] Nagendra NP (2016) 1.
[501] Nagendra NP (2016) 1.
[502] Nagendra NP (2016) 4.
[503] Nagendra NP (2016) 4.
[504] 'Status of International Agreements relating to activities in outer space as at 1 January 2019' available at *http://www.unoosa.org/documents/pdf/spacelaw/treatystatus/AC105_C2_2019_CRP03E.pdf* (accessed 22 April 2019).

to ratify the Moon Agreement have had an adverse effect on its operational value and the objectives that it is attempting to achieve.[505] The Moon Agreement has been viewed as a failure from an international law perspective because it has not gained signatures, accession, or ratification from the major space faring nations.[506] Three spacefaring nations are responsible for the concentration of debris in earth orbit, two of these countries are from BRICS; China is responsible for approximately 42% and Russia for approximately 25,5%.[507] China's responsibility for space debris is due to its intentional anti-satellite test conducted in 2007, whereby China created at least 150 000 pieces of debris.[508] Another major space debris-creating event involved Russia, one of Russia's old military satellites collided with a then-operating Iridium Communications satellite in 2009.[509] Unlike the Chinese incident, the Russian collision was unintentional.[510] However the incident received significant attention, highlighting the possible problems posed within orbits cluttered by space debris.[511]

5.8 CONCLUSION

BRICS recognise space sustainability as a priority, a testament to this would be their involvement in COPUOS, a primary forum for international debate on these issues.[512] Limiting space debris, ensuring access to space, and promoting peaceful use of and activity in space have been identified as key sustainability concerns.[513] Involved to

[505] Hytrek M (2018) 103.
[506] Hytrek M (2018) 103.
[507] Salter AW 'Space Debris: A Law and Economics Analysis of the Orbital Commons' (2016) 19 *Stanford Technology Law Review* 224.
[508] Salter AW (2016) 224.
[509] Salter AW (2016) 224.
[510] Salter AW (2016) 225.
[511] Salter AW (2016) 225.
[512] Lopez L 'Space sustainability approaches of emerging space nations: Brazil, Colombia, and Mexico' (2016) 37 *Space Policy* 28.
[513] Lopez L (2016) 28.

different degrees in the international sustainability related discussions, these actors have begun developing internal guidelines towards limiting the creation of space debris.[514] BRICS have expressed support for the development of international mechanisms to promote outer space sustainability. The issues are related to a consistent view that ensuring access to space for all actors, particularly emerging countries, is fundamental to sustainability. The BRICS countries have expressed support for cooperative efforts to promote space sustainability. The BRICS countries have participated in the United Nations debates and made significant contributions, such as working papers, draft resolutions, and draft treaties. The BRICS countries being developing countries also have a right to explore and utilise the benefits of outer space. With the exception of Russia, the BRICS countries only recently have been / or are becoming emerging space faring nations. Because the BRICS countries are emerging space faring nations and some (i.e. China, Russia and India) have launching capabilities and have launched satellites, have an obligation or duty to preserve the outer space for other developing countries.

[514] Lopez L (2016) 28.

CHAPTER 6: CONCLUSION

Space debris is an international environmental problem that requires immediate attention.[515] Chapter 2 indicated that the growing presence of space debris in both GEO and LEO is one of the greatest practical threats to the continued exploration and use of outer space.[516]

Chapter Three of this research paper dealt with the current international space law dealing with outer space and its shortcomings in addressing space debris. Scrutiny of the current international outer space regime has revealed that there is no definition of space debris.

In Chapter Four, the established international environmental norms such as Principle 21 of the Stockholm Declaration; Sustainable Development; the Precautionary Principle; the Polluter Pays Principle and the CBDR was highlighted. The CBDR&RC under the Paris Agreement the introduces a dynamic and flexible element to interpreting both responsibilities and capabilities, broadening the parameters for differentiation.[517] The CBDR&RC allows for a more complex approach, taking into account a wider criteria, such as past and current, as well as projected, future emissions, and also financial and technical capabilities, human capacity, population size and other demographic criteria, abatement costs, opportunity costs, skills, etc.[518] Differentiation under the Paris Agreement has the potential to function as a catalyst for action, rather than merely a burden-sharing concept.[519] Since the environmental law principles were originally developed for protecting earth they need to be modified

[515] Plantz MR (2012) 595.
[516] Wouters, De Man & Hansen (2016) 66.
[517] Voigt & Ferreira (2016) 294.
[518] Voigt & Ferreira (2016) 294.
[519] Voigt & Ferreira (2016) 303.

to be applicable to solve space debris.[520] Given that outer space is being polluted far faster than it can "clean" itself, the principles are not effective enough to prevent space debris.[521]

In chapter 5 it was indicated that the BRICS countries are emerging space faring nations and have expressed support for cooperative efforts and for the development of international mechanisms to promote space sustainability.

Without a clear legal framework, little progress will be made with respect to the space debris problem.[522] States will continue to exploit outer space without attempting to preserve it. There is increasing awareness of the seriousness of space debris and states have made efforts to mitigate the hazard however it is insufficient to remedy the current space debris.[523] Development of an international legal framework will be crucial in order to actively remove outer space debris.[524] Treaty law is much more effective than customary law and non-binding agreements in handling global issues, such as space debris. Technological and legal efforts must be taken to make the removal of debris from orbit a tangible option.[525]

It is hereby recommended that a new treaty be established in order to address the issue of space debris. This treaty can address the shortcomings of the current international treaties dealing with space debris. A new agreement must provide for the active removal of the current space debris as well as future space debris as this is the

[520] Uchitomi M (2000) 80.
[521] Taylor JB 'Tragedy of the Space Commons: A Market Mechanism Solution to the Space Debris Problem' (2011) 50 *Columbia Journal of Transnational Law* 265.
[522] Salter AW (2016) 237.
[523] Viikari L (2008) 5.
[524] Salter AW (2016 237.
[525] Tronchetti F (2015) 352.

only way to prevent space debris. Principles may be incorporated or used as basis. The CBDR&RC is an important and recently developed principle which is being accepted by states. This principle is incorporated in the Paris Agreement and is applicable to climate change. Space debris is not a consequence of climate change, however the CBDR&RC can be adapted and used to assist in the prevention of future space debris. The new treaty/agreement can incorporate the principle CBDR&RC as established in the Paris Agreement. The new agreement must incorporate the IEL principles mentioned in chapter 4, the CHM, the IADC guidelines as well as the recent CBDR&RC.

Outer space is a CHM, the BRICS countries have a right to explore and utilise the benefits of outer space. All states are free to explore and use outer space, however this has not proved workable for space activities.[526] The outer space is being polluted with space debris, this can impact on the access to outer space and the benefits accompanied with access. The BRICS countries are obligated not to exploit these resources. BRICS recognise space sustainability as importance, a testament to this is their degree of involvement in COPUOS, a primary forum for international debate on these issues.[527] Limiting space debris, ensuring access to space, and promoting peaceful use of and activity in space have been identified as key sustainability concerns.[528] Involved to different degrees in the international sustainability related discussions, these actors have also begun developing internal guidelines towards limiting the creation of space debris.[529] The BRICS countries have participated in the

[526] Mirzaee S (2017) 103.
[527] Lopez L (2016) 28.
[528] Lopez L (2016) 28.
[529] Lopez L (2016) 28.

UN debates, such as working papers, and draft resolutions. The BRICS countries are emerging space faring nations and have launching capabilities and have launched satellites, they have an obligation to preserve outer space for other developing countries. BRICS has an obligation to mitigate against space debris and to put measures into place. While each nation enjoys the full benefits of its satellites or spacecraft, the costs of space debris are fractionally shared among the entire space-faring community.[530] Under the current international treaty regime, no country fully internalises the costs of the space debris it creates and thus no country has a strong incentive to limit or reduce its space debris.[531] Given that no party can prevent other parties from enjoying the benefits of those goods, no party has an incentive to practice responsible stewardship.[532] The long-term sustainability of space operations should be consolidated on ensuring access to outer space by developing states.[533] The presence of space debris threatens the productive use of outer space.[534] The space sector needs to cope with the global differences in development.[535] States were hesitant to address the issue of climate change and only recently have states become more amenable, the Paris Agreement being influential in this. Merely differentiation did not assist the countries i.e. CBDR on its own was not sufficient, it changed from its initial utilisation to be more dynamic and flexible hence CBDR&RC. The Paris Agreement and the CBDR&RC can be an approach to address space debris. The BRICS support the CBDR&RC approach they are all parties to the Paris Agreement and are Non-Annex I countries except Russia.[536] BRICS can be proactive with space

[530] Taylor JB (2011) 260.
[531] Taylor JB (2011) 260.
[532] Salter AW (2016) 228.
[533] Lopez L (2016) 27.
[534] Taylor JB (2011) 260.
[535] Viikari L 2008) 23.
[536] 'United Nations Climate Change' available at *https://unfccc.int/process/parties-non-party-stakeholders/parties-convention-and-observer-*

debris so that we do not reiterate the climate change issue, where the consequence of space debris become so severe and irreversible before action is taken. Some states were reluctant to adopt environmental practices to combat climate change, but with CBDR&RC this has changed, perhaps the CBDR&RC can be utilised to address the space debris problem. BRICS can be a catalyst to incorporate CBDR&RC in a new treaty. This can be done in order to avoid the issues that occurred when addressing climate change where states were hesitant to bind themselves. BRICS are emerging space faring nations and developing countries. By incorporating CBDR&RC to space debris, BRICS can assist with the transfer of technology/resources/expertise, cooperative agreements etc. Efforts should be taken to reduce the creation of space debris and build trust among space actors.[537] Since BRICS have a strong economic impact together, as a collective they can become forerunners in mitigating space debris or to develop initiatives to stop and clean up existing debris. They can assist in ensuring that their future space programs prevent or minimise debris. BRICS can collaborate to preserve the outer space environment as a CHM while utilising its benefits.[538] While recognising that some states, are new to the space community and are not responsible for the current space environment, the CBDR&RC will be a more realistic solution to the space debris problem and can be incorporated in the proposed new treaty dealing with space debris pollution.

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[537] Tronchetti F (2015) 350.

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