

An analysis of the international and South African legal framework relating to outer space pollution

Dawid Dupper

21197768

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Supervisor Dr W Erlank

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List of abbreviations

ARMC	African Resource Management Constellation
COSPAR	Committee on Space Research
EIA	Environmental Impact Assessment
EMP	Environmental Management Plans
ERA	Environmental Risk Assessments
ESA	European Space Agency
GEOSS	Global Earth Observation System of Systems
GEO	Geosynchronous Orbits
GPS	Global Positioning System
IADC	Inter-Agency Space Debris Coordination Committee
ILA	International Law Association
LEO	Low Earth Orbit
MEO	Middle Earth Orbit
NASA	National Aeronautics and Space Administration (United States of America)
NSP	National Space Programme
NEMA	National Environmental Management Act
OST	Outer Space Treaty
SAC	Satellite Applications Centre
SALT	Southern African Large Telescope
SANSA	South African National Space Agency
SKA	Square Kilometre Array Radio Telescope
UNCOPUOS	United Nations Committee on the Peaceful uses of Outer Space
UN	United Nations

Abstract

Since the start of the space race in the 1950's the outer space environment has significantly changed due to human expansion and the subsequent by-products known as outer space pollution/debris. As outer space rapidly evolved from a military high-ground into a commercialised asset exploited by private and state owned enterprises, the treaties negotiated in the 1960's and 1970's quickly became out-dated. As a result outer space, especially the orbits around the Earth are occupied by countless masses of non-functional manmade objects, some expected to remain for millions of years. This dissertation argues that the current national and international legal framework will be inadequate to address the problem of outer space pollution and that legal and political action will be necessary on a global scale. With the planned developments as set out in the *National Space Policy*, South Africa is set on becoming a leading provider of outer space services on the African continent and will, as a consequence, have a progressively bigger impact on the outer space environment. With a growing dependence on outer space technologies, developed and developing economies around the world cannot ignore the immense negative consequences that outer space debris could pose to their development. This study will thus, by examining the international and national legal framework regarding outer space pollution, provide legal recommendations pertaining to the principles and obligations that the South African legal framework will have to make provision for, in order to minimise the negative effect on the outer space environment.

Keywords: outer space law, environmental law, outer space pollution, outer space debris, outer space.

Opsomming

Sedert die begin van die tog na die buitenste ruim in die 1950's het die buitenste ruim merkwaardig verander. Laasgenoemde word toegeskryf aan die toenemende ontwikkeling van die mens in die buitenste ruim en die gevolglike by-produkte of afval wat die buitenste ruim tans besoedel. Met die omskakeling van die buitenste ruim na 'n kommersiële bate het die bestaande verdrae vanuit die 1960's en 1970's vinnig ouderwets en ontoepaslik geraak. Met die tekort aan voldoende regulering het die wentelbane om die aarde met ontelbare massas onfunksionele mensgemaakte voorwerpe besoedeld geraak en blyk dit die stand van sake vir die voorsienbare toekoms te wees. Daar word dus in hierdie skripsie beklemtoon dat die huidige nasionale en internasionale ruimtereg-raamwerk oneffektief sal wees om die hierdie probleem aan te spreek en dat globale regs-en politieke optrede benodig sal word. Met die voorgestelde ontwikkeling soos uiteengesit in die National Space Policy poog Suid-Afrika om die leier op die gebied van ruimtetegnologie in Afrika te word en sal gevolglik 'n toenemende impak hê op die buitenste ruim. Met die groeiende afhanklikheid van ruimtegebaseerde tegnologie sal ontwikkelde sowel as ontwikkelende lande soos Suid-Afrika met geen ander keuse gelaat word as om voorsorgmaatreëls te tref nie. Die studie poog dus om die internasionale en nasionale ruimtereg-raamwerk te ondersoek ten einde aanbevelings te kan maak rakende die regsvereistes en oplossings wat Suid-Afrika in ag sal moet neem om die negatiewe impakte van toekomstige ontwikkelings in die buitenste ruim te beperk.

Sleutelwoorde: ruimtereg, omgewingsreg, besoedeling, afval, buitenste ruim.

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*Problems cannot be solved by the same level of thinking
that created them.*

- Albert Einstein

1 Introduction

The expansion of human activities into outer space started in the 1950's during the Cold War when East and West were divided by the so-called "iron curtain" and many countries feared that outer space would be used for military purposes.¹ With the launch of Sputnik 1 in 1957 the world realised that outer space was now within reach of mankind but also raised questions such as who would own outer space and which laws would regulate the use of outer space.² The birth of the *corpus juris spatialis* (outer space law) may possibly be attributed to the space race between Russia/Soviet Union and the United States to the Moon³ as well as to the establishment of the "mankind clause" in the Outer Space Treaty,⁴ stating that outer space belongs to humankind and that there is no sovereignty over outer space.⁵

To address the concerns pertaining to the use of outer space the international community agreed to five main outer space treaties to regulate outer space, which include: The *Outer Space Treaty*, *Rescue Agreement*,⁶ *Liability Convention*,⁷ *Registration Convention*,⁸ and the *Moon Agreement*.⁹ In 1994 the United Nations Committee on the Peaceful uses of Outer Space (UNCOPUOS) under the *Outer Space treaty* considered for the first time, on a priority basis, matters associated

1 Sabathier and Faith 2008 *Brown J World Aff* 147.

2 Bressack 2011 *Geo Wash Int'l L Rev* 745.

3 For the purposes of this study the Moon and other celestial bodies are written with capital letters in accordance with the general practice in this field of Law.

4 *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 (hereafter referred to as the *Outer Space Treaty*).

5 Article I of the *Outer Space Treaty*, 1967.

6 *Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space* of 1968 (hereafter referred to as the *Rescue Agreement*).

7 *Convention on International Liability for Damage Caused by Space Objects* of 1972 (hereafter referred to as the *Liability Convention*).

8 *Convention on Registration of Objects Launched into Outer Space* of 1975 (hereafter referred to as the *Registration Convention*).

9 *Agreement Governing the Activities of States on the Moon and Other Celestial Bodies* of 1979 (hereafter referred to as the *Moon Agreement*).

with space debris.¹⁰ In 2007 the General Assembly endorsed the *Space Debris Mitigation Guidelines* of the Committee on the Peaceful Uses of Outer Space and agreed that the voluntary guidelines for the mitigation of space debris reflected the existing practices as developed by a number of national and international organisations such as the *Inter-Agency Space Debris Coordination Committee (IADC)*, and invited member states to implement those guidelines through relevant national mechanisms.¹¹ The international space sector will continue to grow, making environmental consideration not only a necessity to protect the common heritage for future generations but also for the sustainable economic use of outer space.

South Africa has ratified most of the main international treaties.¹² Some of the South African legal instruments regulating the use of outer space include: the *Space Affairs Act*,¹³ the *Space Affairs Amendment Act*,¹⁴ the *National Space Agency Act*,¹⁵ and the *National Space Policy*¹⁶ published in 2008. The *National Space Policy* sets out South Africa's own development path in outer space, setting the course for transitioning into a knowledge based economy through the development and maintenance of appropriate, efficient and robust space capabilities.¹⁷ The *National Space Policy* further states that, under the Department of Trade and Industry, South Africa will develop and foster infrastructure for ground segment operations of space systems, satellite assembly, testing and integration, as well as facilities to support flight testing and space launch activities in order to become self-sufficient and internationally competitive.¹⁸ This means that the relatively small impact currently made by South Africa could possibly change in the near future, necessitating appropriate supporting legislation.

10 *United Nations Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space* (2010).

11 *United Nations Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space* (2010).

12 Department of foreign affairs 2013 www.dfa.gov.za/foreign/Multilateral/inter/copuos.htm.

13 *Space Affairs Act* 84 of 1993.

14 *Space Affairs Amendment Act* 64 of 1995.

15 *National Space Agency Act* 21 of 2007.

16 *National Space Policy* of 2008.

17 Par 4 of the *National Space Policy* (2008).

18 Par 7.4 of the *National Space Policy* (2008).

South Africa aims to support and promote relevant scientific research, capacity-building, innovation, and industrial development, with the aim of utilising space applications to contribute to economic growth, reduction of poverty, and the creation of knowledge.¹⁹ The promotion of a domestic space industry is one of the cornerstones of the *Space Policy* and it is, therefore, expected that South Africa will also progressively have a bigger impact on the outer space environment. South Africa has recently (2012) been awarded the majority share of the Square Kilometre Array Radio Telescope or SKA, a multi-billion dollar telescope project, which will significantly promote the space sector in South Africa and undoubtedly extend and fund further space projects.²⁰ South Africa is “committed to being a responsible user of the outer space environment and will ensure that all public and private sector activities are conducted in accordance with national legislation and appropriate international best practices, in addition to relevant international treaties”.²¹ Having said this, there is currently no national legislation giving effect to this statement and regulating the outer space environment, except for possible framework provisions in the *National Environmental Management Act*,²² sectoral acts and general constitutional provisions. According to the *Constitution*,²³ South Africa is bound by international agreements and must abide by international law consistent with the Constitution.²⁴ It is, therefore, expected that South Africa will need to comply with current international law by adopting relevant national legislation that conform to the dictates of the international legal framework. This study will thus, by examining the international and national legal framework regarding outer space pollution, provide legal recommendations pertaining to the principles and obligations that the South African legal framework will have to make provision for, in order to minimise the negative effect on the outer space environment.

19 Par 3 of the *National Space Policy* (2008).

20 September 2013 *Fifty-second session of the Legal-Subcommittee on the peaceful use of outer space* –4.

21 Principles of the *National Space Policy*, 2008.

22 *National Environmental Management Act* 107 of 1998 (hereafter referred to as *NEMA*).

23 *Constitution of the Republic of South-Africa*, 1996 (hereafter referred to as the Constitution).

24 Ss 231–233 of the *Constitution*.

2 The current state of the outer space environment

In order for South Africa to realise the developments proposed in the *National Space Policy*, it is necessary to understand concepts such as “space pollution”, the outer space environment as well as the negative effects that space debris will have on this valuable and limited resource. The outer space environment and more specifically the orbital environment is currently taken for granted due to the fact that humanity generally suffers from the “disposable planet” mentality.²⁵ In the following section of this dissertation a number of important factors require further discussion, these include: The outer space environment and orbits, the classification and origin of space debris, the consequences of space debris and lastly the stakeholders and key role-players in outer space activities.

2.1 The outer space environment explained

The outer space environment can be defined as “that part of the universe beyond the Earth’s atmosphere”.²⁶ This definition though, is very broad and some boundaries are necessary to apply the outer space environment within the scope and application of this study. It is first and foremost important to note that there is no fixed border where the Earth’s atmosphere ends and outer space starts.²⁷ This is due to the fact that the atmosphere is constantly contracting and expanding, triggered by solar activity and other influences.²⁸ In the thermosphere, around 80 to 100 km above the Earth’s surface, the atmosphere thins to such an extent that there are almost no more particles.²⁹ It is, therefore, widely accepted that the outer space environment starts at approximately 100 kilometres.³⁰ Human activities in outer space are mostly done within certain defined orbits around the Earth. Earth’s orbits are home to most satellites and manned space missions of which most of the world is critically reliant on for communications, information

25 Disposable planet mentality is the mistaken belief that most resources, such as orbital resources, are infinite; Viikari *Environmental Element in Space Law* 17.

26 Williamson *The Fragile Frontier* 27.

27 Baker *Emerging Principles of International Environmental Law* 21.

28 Taylor 2007 *Geo Int'l Env L Rev* 4.

29 Baker *Emerging Principles of International Environmental Law* 21.

30 Taylor 2007 *Geo Int'l Env L Rev* 6.

transfer, Earth observation, military and state security as well as astronomy, just to name a few.³¹ Three special orbits around the Earth are of particular use and value to us and should, therefore, be discussed in further detail.

2.1.1 *The Low Earth Orbit (LEO)*

The Low Earth Orbit (LEO) starts at about 200 kilometres and ends at around 1000 kilometres from earth and is one of the most used and important orbits around the earth.³² The LEO is of particular value since it is in close proximity to Earth and satellites can cover vast distances in a relatively short period of time.³³ The LEO is used for commercial as well as military remote sensing since this orbit offers the best resolutions for imaging.³⁴ It is also more economical to use the LEO as it takes less fuel to place objects in this orbit and smaller spacecraft can be used here, it is, therefore, likely to be used by South Africa in the future. All manned missions, except for the lunar missions, have taken place in the LEO.³⁵

The LEO has been home to South Africa's first two satellites, namely *Sunsat*, a 64 kg microsatellite launched in 1999 and the larger *Sumbandila* satellite launched in 2009 both used for remote sensing and imaging.³⁶ This orbit will also be home to space tourism activities, ranging from trips in a modified Boeing 727 that performs parabolic arcs to create a weightless environment to orbital and suborbital trips in modified spacecraft.³⁷ Virgin Galactic followed after Sir Richard Branson announced that the Virgin Company will be venturing into space tourism in 2004 and even predicted a future space hotel.³⁸ The second person ever to take advantage of space tourism was the South African entrepreneur Mark Shuttleworth, paying roughly an amount of \$20 million to take an orbital flight

31 Williamson *The Fragile Frontier* 32.

32 Taylor 2007 *Geo Int'l Env L Rev* 6.

33 Williamson *The Fragile Frontier* 35.

34 Taylor 2007 *Geo Int'l Env L Rev* 6.

35 Taylor 2007 *Geo Int'l Env L Rev* 6.

36 Gottschalk 2010 *Astropolitics* 8.

37 The United States saw a major change in the law with the *Commercial Space Launch Amendments Act* of 2004. This act saw the first national regulation of a commercial space tourism market and establishes licensing requirements for taking paying passengers on suborbital flights.

38 Williamson *The Fragile Frontier* 113.

around the Earth.³⁹ Suborbital flights as a form of adventure tourism may soon make spaceflight an everyday reality for all, therefore making space pollution and debris not only a commercial threat but also a possible threat to human life. Space debris found in LEO has an expected lifespan of only a few months as the drag of the upper atmosphere causes these objects to eventually fall back to Earth and disintegrate due to friction.⁴⁰ However, this depends on the weight, size, altitude and mass of the object as well as the amount of solar activity present.⁴¹ This changes rapidly as an object at an altitude of only 400 km could have a lifespan of a few years to even a few hundred years, increasing in lifespan as the distance from Earth increases.⁴²

2.1.2 *The Middle Earth Orbit (MEO)*

The MEO is located at altitudes of around 10 000 kilometres.⁴³ The MEO is not as widely used as the LEO as this orbit does not offer the imaging capabilities of LEO or the fixed positioning offered by the Geosynchronous Orbits (GEO).⁴⁴ There are, however, still advantages to the MEO as it is used for Global Positioning Systems (GPS) and other communication satellites.⁴⁵ The MEO is also used for the observation and study of the other orbits. Space debris in the MEO can last for thousands of years and can be classified as long-lived debris, a massive risk to satellites using this orbit.⁴⁶

2.1.3 *Geosynchronous Orbits (GEO)*

There are a range of geosynchronous orbits around the Earth but focus will be given to the geostationary orbit since most communication satellites are positioned at around 35 786 kilometres from the Earth.⁴⁷ Satellites are stationed at

39 Williamson *The Fragile Frontier* 113.

40 Viikari *Environmental Element in Space Law* 36.

41 Taylor 2007 *Geo Int'l Env L Rev* 6.

42 Taylor 2007 *Geo Int'l Env L Rev* 6.

43 Williamson *The Fragile Frontier* 35.

44 Pusey 2010 *Col J Int'l Env L & Pol'y* 428.

45 Williamson *The Fragile Frontier* 35.

46 Taylor 2007 *Geo Int'l Env L Rev* 6.

47 Williamson *The Fragile Frontier* 35.

a fixed position around the equator where satellites complete an orbit at a stationary position relative to the earth.⁴⁸ This orbit is in view of almost half of the earth and is commonly used for broadcasting, weather services and telecommunications satellites.⁴⁹ This orbit is extremely valuable and is regarded as “prime property” in outer space due to the fact that satellites are stationary relative to Earth and they do not require ground based tracking.⁵⁰ This orbit is, therefore, one of the most congested as only a limited number of satellites can remain in certain positions relative to Earth.⁵¹ The amount of satellites in this orbit also increases the possibility of collisions and frequency interference between satellites.⁵²

This area is governed by the *International Telecommunications Union*⁵³ (ITU) and is under its own unique legal system to deal with the congestion in this orbit.⁵⁴ Satellite operators must apply to the ITU for authorisation to use a certain location or frequency within the GEO, the satellite will then be listed within the Master International Frequency Register after the ITU has confirmed that the location is available.⁵⁵ The drawback in using the GEO is that it is more expensive to place satellites here as a multi-stage launch vehicle is used requiring more fuel and creating more debris.⁵⁶ Space debris found in the GEO is estimated to last for millions of years and satellites must actively dodge debris moving in this area around the Earth.⁵⁷

48 Taylor 2007 *Geo Int'l Env L Rev* 6.

49 Taylor 2007 *Geo Int'l Env L Rev* 6.

50 Williamson *The Fragile Frontier* 35.

51 Taylor 2007 *Geo Int'l Env L Rev* 7.

52 Taylor 2007 *Geo Int'l Env L Rev* 7.

53 *International Telecommunications Union* (hereafter referred to as the ITU).

54 Taylor 2007 *Geo Int'l Env L Rev* 7.

55 Pusey 2010 *Col J Int'l Env L & Pol'y* 428.

56 Limperis 1998 *Ariz J Int' & Comp L* 322.

57 Taylor 2007 *Geo Int'l Env L Rev* 7.

2.2 What is outer space pollution/debris?

Space debris or pollution⁵⁸ is a wide-ranging international term referring to a myriad of forms of space junk or derelict manmade objects launched into outer space. The international community has not yet come to the point of comprehensively defining space debris but has included a definition proposed by the IADC in the UNCOPUOS space debris mitigation guidelines of 2007 which defines space debris as:

All man-made objects, including fragments and elements thereof, in Earth orbit or re-entering the atmosphere, that are non-functional.⁵⁹

Tan defines space debris as "any man-made earth-orbiting object which is non-functional with no reasonable expectation of assuming or resuming its intended function or any other function for which it is or can be expected to be authorized."⁶⁰ Operational satellites⁶¹ are capable of manoeuvring around space debris and as long as satellites are still useful, they are not considered space debris, only when these satellites are discarded and lose all function will they be classified as space debris. Although this definition does provide a positive contribution towards the problem of space debris, it is not formally part of any binding international treaty and is, therefore, nothing more than a guideline open to interpretation.

2.2.1 Outer space pollution and orbital debris classified

Sources of space debris can be divided into four categories, namely: fragmentation debris, operational debris, inactive payloads and micro particulate

58 Space debris/pollution will be used interchangeably in this study. Space debris that occur naturally are however separated and excluded from the scope of this study as these objects are not manmade and cannot be removed, altered or controlled by mankind and should therefore not be considered as pollution.

59 Background in the *United Nations Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space* (2010).

60 Tan 2000 *Yale J Int'l L* 8.

61 Operational satellites are objects that are associated with on-going space activities which remain in space and is still in use.

matter.⁶² Fragmentation debris constitutes around 85% of all orbital debris and is created when objects like satellites break apart into smaller fragments.⁶³ Breakups are mostly a result of explosions, collisions, deterioration and deliberate destruction.⁶⁴ Inactive payloads are primarily inoperative satellites that are discarded when they malfunction or run out of fuel to manoeuvre.⁶⁵ Operational debris and rocket bodies are discarded derelict objects used in the launch and normal operations of the satellite or spacecraft and may include tools and component parts.⁶⁶ The last source of space debris is micro particulate matter and is created through surface deterioration caused by the harsh conditions of outer space. This source of pollution consists of droplets of fuel, specs of paint and other shedding or material found in small particles of debris.⁶⁷ Space pollution also manifests in other forms such as nuclear contamination, interferences with signals and exobiological contamination.⁶⁸

2.2.2 The consequences of outer space debris

There are a number of negative effects caused by space debris. The first and most apparent effect of debris is the damage caused by the mere presence thereof to the outer space environment as well as man-made objects like satellites and spacecraft in outer space. According to the January 2012 UNCOPUOS⁶⁹ report 21,000 space objects larger than 10 cm are currently orbiting the Earth and being actively tracked.⁷⁰ There are also an additional 450,000 to 600,000 objects measuring between 1 and 10 cm, including countless millions measuring between 1 millimetre and 1 centimetre in size.⁷¹ The amount of space debris is only one part of the overall problem since the velocities at which these objects travel are

62 Sénéchal 2007 www.spacegeneration.org 41.

63 Viikari *Environmental Element in Space Law* 35.

64 Sénéchal 2007 www.spacegeneration.org 42.

65 Sénéchal 2007 www.spacegeneration.org 41.

66 Sénéchal 2007 www.spacegeneration.org 41.

67 Sénéchal 2007 www.spacegeneration.org 42.

68 Sénéchal 2007 www.spacegeneration.org 42.

69 *United Nations Committee on the Peaceful Uses of Outer Space* (hereafter referred to as UNCOPUOS).

70 UNCOPUOS 2012 *Active Debris Removal - An Essential Mechanism for Ensuring the Safety and Sustainability of Outer Space* 10.

71 UNCOPUOS 2012 *Active Debris Removal - An Essential Mechanism for Ensuring the Safety and Sustainability of Outer Space* 10.

the actual dangerous factor. Space debris travel at around 28 000 km/h, giving a 1cm object the ability to disable an average size satellite on collision.⁷² Droplets of fuel, 1cm in diameter, moving at around 10 km/s could have the destructive power of a hand grenade and a 10cm object could have the same amount of destructive power contained within 25 sticks of dynamite.⁷³ Collisions with space debris also cause disruptions as precisely positioned satellites are knocked of balance or short circuit due to electrical charges.⁷⁴ Space debris and the power of their impacts also pose a threat to manned missions as validated by the several space shuttle windows that have already been replaced due to previous impacts.⁷⁵

One of the biggest dangers associated with space pollution is nuclear contamination caused by debris from Cold War satellites containing radioactive components.⁷⁶ Nuclear contamination is a risk during the launching phase as well as during the operational phase. An estimated 1500 kilograms of radioactive material is currently in orbit around the earth, mostly in LEO, not only posing a threat to activities in outer space but also to life on earth.⁷⁷ Nuclear reactors as a power source have received renewed attention after the last nuclear powered satellite was launched in 1988, most likely to be used in high-powered craft and deep space missions and even to establish bases on other planetary bodies.⁷⁸ The problem of radioactive contamination is further intensified by the nature of space debris itself, being likely to collide and multiply due to the cascade effect. The cascade effect is a phenomenon where space debris collides, breaks apart and then continues to collide with other spacecraft or debris, creating even more debris.⁷⁹

These collisions, therefore, increase the risk of nuclear explosions in outer space, explosions that are far worse than on earth as there is no atmosphere to absorb

72 S n chal 2007 www.spacegeneration.org 44.

73 S n chal 2007 www.spacegeneration.org 44.

74 Pusey 2010 *Col J Int'l Env L & Pol'y* 430.

75 Pusey 2010 *Col J Int'l Env L & Pol'y* 430.

76 Akers 2012 *U La Verne L Rev* 290.

77 Akers 2012 *U La Verne L Rev* 290.

78 Viikari *Environmental Element in Space Law* 46.

79 Stayduhar 2006 *Pitts U J Tech L & Pol'y* 6.

some of the impact, resulting in a more dangerous and powerful explosion.⁸⁰ Nuclear contamination can, therefore, easily spread over thousands of kilometres and even damage or destroy electronic equipment in outer space.⁸¹ This also occurs where residual fuel is left in upper stages of rockets which later explode due to heat from the sun, spreading debris over many orbits, accounting for about 40% of debris in outer space.⁸² In 1978 the Soviet satellite Cosmos 954 crashed into Canada after an un-programmed re-entry occurred.⁸³ This was caused by the decay of the orbit it was travelling in. Cosmos 954 was a uranium-fuelled satellite, causing hazardous radioactive material to scatter over a large part of uninhabited territory in Canada.⁸⁴ After diplomatic negotiations, the Soviet Union paid Canada approximately \$3 million dollars in compensation, if this had happened in a populated area the amount of damages incurred would have been unthinkable.⁸⁵ Re-entry of space debris is also one of the major concerns, since objects that withstand re-entry may cause damage to persons, property or animals.⁸⁶ More than 200 pieces of space debris re-enter the earth's atmosphere each year and there has even been at least one reported case where a person was hit by space debris.⁸⁷ This number will undoubtedly increase if the necessary steps are not taken to prevent space debris from occurring.

Astronomers also face increased difficulties as a result of space debris and the overcrowding of certain orbits around the Earth. Space debris poses a threat to optical and radio astronomy, an important consideration for South Africa in view of the SKA project⁸⁸ and other important telescopes situated in South Africa.⁸⁹ Astronomers require lengthy periods of time to study stars and distant galaxies with as little as possible interference.⁹⁰ However, this has become very difficult as

80 Viikari *Environmental Element in Space Law* 47.

81 Viikari *Environmental Element in Space Law* 47.

82 Williamson *The Fragile Frontier* 48.

83 Akers 2012 *U La Verne L Rev* 290.

84 Viikari *Environmental Element in Space Law* 48.

85 Stayduhar 2006 *Pitts U J Tech L & Pol'y* 11.

86 Taylor *Orbital Debris* 37.

87 Taylor *Orbital Debris* 37.

88 The SKA project (Square Kilometre Array) is a project with the aim to build the world's largest radio telescope by 2024, with the majority of satellites to be built in South Africa.

89 Such as MEERKAT and the Southern African Large Telescope (SALT).

90 Böckstiegel *Environmental aspects* 71.

many survey plates are rejected and data lost due to satellites and other objects passing by.⁹¹ Some detectors/survey plates can even be damaged by bright objects passing by unexpectedly.⁹² These are just some of the negative consequences of space debris and the chances of further damages occurring will only increase as mankind continues to exploit outer space without the due regard for the protection of the outer space environment.

2.3 Key role-players and stakeholders in addressing outer space pollution

All of humanity can be regarded as stakeholders in outer space as most outer space treaties refer to outer space as the “province of all mankind”, “common heritage of mankind” and “for the benefit of all countries”.⁹³ The common heritage principle will, therefore, be discussed further under the international legal framework regarding outer space pollution. Over the last fifty years the outer space sector has evolved into a multi-national global industry where private entities have an ever-increasing role to play. States, nevertheless, remain the most important role-players as they are responsible for ensuring that space activities are carried out in accordance with international law and that those private entities under their jurisdiction also comply with international and domestic space law.⁹⁴ The following entities are some of the most important and influential key role-players and stakeholders in addressing the problem of outer space pollution.

The ITU, founded in 1865, is a specialised organisation functioning under the United Nations to facilitate telecommunications worldwide.⁹⁵ The ITU represents primarily member states with voting rights but also provides the opportunity for the public and private sector members, manufacturers and service providers to

91 Bockstiegel *Environmental aspects* 71.

92 Bockstiegel *Environmental aspects* 72.

93 Viikari *Environmental Element in Space Law* 21; some of these treaties include the Outer Space Treaty 1967, The Moon Agreement, Liability Convention etc.

94 Article VI of the *Outer Space Treaty* 1967.

95 Viikari *Environmental Element in Space Law* 85.

participate.⁹⁶ The ITU has evolved over time into a body that now regulates the use of certain radio spectrums, the use of the GEO and the establishment of international standards for equipment.⁹⁷ The ITU is of significant importance as all countries make use of telecommunications and are assigned certain frequencies by the ITU in order to guarantee undisturbed signals and international cooperation.⁹⁸ The ITU functions within the boundaries of the *Radio Regulations*,⁹⁹ a combination of the ITU's constitution, convention, conferences and agreements that have the binding nature of treaties between the member states.¹⁰⁰ The biggest concern to the ITU, although not explicitly environmental, is the disturbances in radio frequencies that are caused by the overcrowding in the GEO as well as space debris.¹⁰¹ The ITU, since the 1970's, raised its concerns regarding the GEO, stating that the GEO is a limited natural resource that should be used rationally, efficiently and economically.¹⁰²

The *Inter-Agency Space Debris Coordination Committee* (IADC)¹⁰³ is a multi-national agency established in 1993, comprising of space agencies from around the world such as Russia, the United States of America and Japan, with the aim to cooperate and address the issue of space debris and other important matters associated with outer space.¹⁰⁴ The IADC facilitates cooperation regarding the mitigation of space debris and has created the Space Debris Mitigation Guidelines of 2002, calling for the minimisation of space debris and the disposal of spacecraft into junkyard orbits in the post-mission phase.¹⁰⁵ The mitigation guidelines by the IADC was the first international document to focus solely on space debris and provides a basic framework or standard for mitigating space debris.¹⁰⁶ The International Law Association (ILA),¹⁰⁷ also concerned with the issue of space

96 Howard *Private Space Law* 31.

97 Viikari *Environmental Element in Space Law* 85.

98 Viikari *Environmental Element in Space Law* 85.

99 ITU *Radio Regulations*, 2004/2008.

100 Viikari *Environmental Element in Space Law* 86.

101 Viikari *Environmental Element in Space Law* 87; Pusey 2010 *Col J Int'l Env L & Pol'y* 428.

102 Viikari *Environmental Element in Space Law* 87, Article 44.2 of the Convention of the ITU.

103 Inter-Agency Space Debris Coordination Committee (hereafter referred to as the IADC).

104 Viikari *Environmental Element in Space Law* 94.

105 Viikari *Environmental Element in Space Law* 94.

106 Viikari *Environmental Element in Space Law* 95.

107 International Law Association (hereafter referred to as the ILA).

debris already drafted its own Draft Convention on Space Debris in 1994.¹⁰⁸ The United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS)¹⁰⁹ was established in the 1950's and is seen as the centre of developments concerning international space law.¹¹⁰ South Africa became a member of UNCOPUOS in 1994.¹¹¹ UNCOPUOS has the following goals:

1. Review the scope of international cooperation in peaceful uses of outer space;
2. Devise programmes in this field to be undertaken under United Nations auspices;
3. Encourage continued research and the dissemination of information on outer space matters and;
4. Study legal problems arising from the exploration of outer space.¹¹²

UNCOPUOS has been working towards elaborating space law with the help of two subcommittees working towards this goal, namely the Legal subcommittee and the Scientific and Technical subcommittee.¹¹³ UNCOPUOS, now one of the biggest committees under the UN, comprises of 67 member states along with other international organisations as observers.¹¹⁴ In 1994 UNCOPUOS under the *Outer Space treaty* considered for the first time, on a priority basis, matters associated with space debris.¹¹⁵ UNCOPUOS also adopted their own set of space debris mitigation guidelines in 2007, these guidelines were based in the IADC guidelines and any amendments to these guidelines are usually done in coordination with the IADC.¹¹⁶ Both the IADC and the UNCOPUOS mitigation guidelines will be discussed in further detail under the international legal framework on outer space pollution. The NASA Orbital Debris Programme Office is also considered a leader in addressing the problem of space debris, focusing on limiting the growth of space debris and protecting users of the outer space

108 Viikari *Environmental Element in Space Law* 102.

109 United Nations Committee on the Peaceful Uses of Outer Space (hereafter referred to as the UNCOPUOS).

110 Viikari *Environmental Element in Space Law* 97.

111 Department of foreign affairs 2013 www.dfa.gov.za/foreign/Multilateral/inter/copuos.htm.

112 Sénéchal 2007 www.spacegeneration.org 49.

113 Viikari *Environmental Element in Space Law* 97.

114 Viikari *Environmental Element in Space Law* 98.

115 *United Nations Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space* (2010).

116 Viikari *Environmental Element in Space Law* 98.

environment.¹¹⁷ NASA works closely with the Scientific and Technical Subcommittee under UNCOPUOS, promoting the mitigation guidelines.¹¹⁸

3 The international legal framework on outer space pollution

The following treaties, conventions and agreements were created and negotiated through the UNCOPUOS and adopted by the UN General Assembly. The *Outer Space Treaty*, *Rescue Agreement*, *Liability Convention*, *Registration Convention* and the *Moon Agreement* all govern a wide range of aspects related to the use and exploration of outer space. There are also five UN general assembly resolutions, including the Declaration of Legal Principles that extends the regulation of the outer space environment.¹¹⁹ These agreements do include some aspects of environmental consideration but generally fail to provide comprehensive protection of the outer space environment.¹²⁰ The following international instruments will thus be discussed accordingly to indicate whether they succeed or fail to address the problem of outer space pollution.

3.1 The Outer Space Treaty of 1967 and the Common Heritage of Mankind Principle

The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies or Outer Space Treaty (OST)¹²¹ is seen as the constitution of the *corpus juris spatialis* and came into force on 10 October 1967.¹²² This means that the OST came into

117 S n chal 2007 www.spacegeneration.org 47.

118 S n chal 2007 www.spacegeneration.org 47.

119 These include: The Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space adopted on 13 December 1963 (resolution XVIII); The Principles Governing the Use by States of Artificial Earth Satellites for International Direct Television Broadcasting adopted on 10 December 1982 (resolution 37/92); The Principles Relating to Remote Sensing of the Earth from Outer Space adopted on 3 December 1986 (resolution 41/65); The Principles Relevant to the Use of Nuclear Power Sources in Outer Space adopted on 14 December 1992 (resolution 47/68); The Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries adopted on 13 December 1996 (resolution 51/122).

120 Roberts 1992 *BC Int'l & Comp L Rev* 52.

121 *Outer Space Treaty* (hereafter referred to as the OST).

122 Williamson *The Fragile Frontier* 150.

existence at a time when space exploration was so difficult and expensive that no one could have predicted problems such as overcrowding of orbits and pollution in outer space.¹²³ As from 2007 the OST has been ratified by 98 states, including South Africa¹²⁴ and signed by 27 countries, consequently becoming customary international law and, therefore, applicable to and legally binding on countries that are not formally parties to the treaty.¹²⁵ The applicable articles and sections under the OST will now be discussed in further detail to highlight how they succeed or fail to address the regulation of outer space debris.

Firstly article I of the OST holds 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 interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind. Outer space, including the Moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies. There shall be freedom of scientific investigation in outer space, including the Moon and other celestial bodies, and States shall facilitate and encourage international cooperation in such investigation.¹²⁶

Article I of the OST refers to the equality and freedom given to all in exploring and utilising the outer space environment. Article I also includes phrases such as “for the benefit and interest of all countries” and “province of all mankind” which are linked to the concept of the common heritage of mankind principle or “commons”, of which outer space is regarded as such. The development of the common heritage principle as a legal concept first came to the attention of the world 1967 when Malta’s United Nations representative Arvid Pardo advocated that the deep-seabed and its subsoil be declared a common heritage of mankind.¹²⁷ This was as a result of fears that the developed and technologically advanced nations would

123 Pusey 2010 *Col J Int'l Env L & Pol'y* 435.

124 Department of foreign affairs 2013 www.dfa.gov.za/foreign/Multilateral/inter/copuos.htm.

125 Hofmann 2007 *SAYIL* 234.

126 Article I of the *Outer Space Treaty* 1967.

127 Scholtz 2008 *Comp & Int'l LJSA* 274.

once again ravage and exploit natural resources found in the deep-seabed and leave developing countries with no say in the matter and without any benefits.¹²⁸

The origins of the common heritage of mankind principle as it relates to space law can be traced back to the start of the *corpus juris spatialis* at a time when the world was in fear of a nuclear attack from space and the international community decided that outer space must be separated from the struggles of Earth and should be used only for peaceful purposes.¹²⁹ The common heritage of mankind principle as part of international law is, therefore, applicable to Antarctica, the deep-seabed and Outer Space and can be explained through five main characteristics.¹³⁰ These characteristics are discussed by Scholtz as follows: Firstly these areas are not viable or subject to appropriation, therefore no person or state may own or claim these areas.¹³¹ Secondly these areas are managed and shared by all of mankind equally, meaning that states as representatives of mankind must manage these areas but cannot claim sovereignty.¹³² Thirdly, one of the more contentious elements of this principle is that all benefits gained by exploitation of these areas must be shared by all of mankind.¹³³ Fourthly common heritage areas may only be used for peaceful purposes, meaning any military conflict or military operations with the aim of conflict are prohibited in these areas.¹³⁴ Lastly, these areas must be protected and preserved for future generations referring to intergenerational equity also found in environmental law principles.¹³⁵

The common heritage principle is clearly another indication that outer space as an environment must also be protected for humanity and its future generations and not only for securing outer space assets. These characteristics are clearly visible

128 Scholtz 2008 *Comp & Int'l LJSA* 275.

129 Porras 2006 *Cal W Int'l LJ* 152.

130 The possibilities and uses of outer space is however substantially different from areas such as Antarctica and the deep seabed, requiring a different approach to regulation and protection.

131 Scholtz 2008 *Comp & Int'l LJSA* 275.

132 Scholtz 2008 *Comp & Int'l LJSA* 275.

133 Scholtz 2008 *Comp & Int'l LJSA* 275.

134 Scholtz 2008 *Comp & Int'l LJSA* 275.

135 Scholtz 2008 *Comp & Int'l LJSA* 275.

in the OST as well as other agreements governing the outer space. Article I of the OST confirms that the rights of developing countries are protected and exploitation should benefit all, regardless of their level of development. There is not only a protection of rights and freedom but a positive obligation on states to cooperate in the scientific investigation of outer space. Article I, however, only requests the user of outer space to act responsibly, without any real consequences if they do not.¹³⁶ Article II of the OST further adds that:

Outer space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means.¹³⁷

Article II of the OST clearly reaffirms the common heritage of mankind principle and is similar to treaties that govern the deep seabed and Antarctica, prohibiting appropriation and provides for equitable access and use. The common heritage principle meant in reality that states would have equitable access to outer space as long as there were no military purposes in utilising outer space.¹³⁸ The treaty, however, fails to provide a guideline on how outer space can be managed and how these benefits could be shared.¹³⁹ Access to outer space will also clearly be restricted in future due to outer space debris and overcrowding. Some authors have even gone so far as to argue that the overcrowding and placement of debris in outer space must be viewed as a form of appropriation, because an object in outer space does occupy a certain area, consequently precluding others from using the same area.¹⁴⁰ Equitable and free access to outer space is, therefore, just another part of the OST that has given a right but failed to provide the necessary measures for protection, meaning users would have free access but at their own risk.¹⁴¹ Article III of the OST continues to lay the foundation of the access and use of outer space as well as staying within the characteristics of the common heritage of mankind principle, stating that:

136 Williams 1994 *J Air L & Com* 1152.

137 Article II of the *Outer Space Treaty* 1967.

138 Porras 2006 *Cal W Int'l LJ* 170.

139 Scholtz 2008 *Comp & Int'l LJSA* 281.

140 Williams 1994 *J Air L & Com* 1153.

141 Williamson *The Fragile Frontier* 156.

States Parties to the Treaty shall carry on activities in the exploration and use of outer space, including the Moon and other celestial bodies, in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security and promoting international cooperation and understanding.¹⁴²

Article III clearly refers to the peaceful use of outer space, protecting the outer space from devastating actions such as the use of weapons of mass destruction in outer space.¹⁴³ These actions could significantly add to the deterioration of the outer space environment, making this not only a consideration for the safety and security in outer space but also an environmental consideration. It also reaffirms the applicability of other international law on the outer space environment. Article IV of the OST links to Article III and reaffirms that outer space may only be used for peaceful purposes, prohibiting any type of weapon usage in outer space.¹⁴⁴ The next applicable article under the OST is Article VI, referring to the responsibility for activities in outer space. Article VI of the OST states that:

States Parties to the Treaty shall bear international responsibility for national activities in outer space, including the Moon and other celestial bodies, whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the present Treaty...¹⁴⁵

This article under the OST is of particular importance considering the increase in non-state activities in outer space. From this part of the treaty there is a clear obligation on states to ensure that their nationals do not violate the OST as they will bear the responsibility for those activities, even if these activities are done in private capacity.¹⁴⁶ The article, however, lacks any preventative measures,

142 Article III of the *Outer Space Treaty* 1967.

143 Williamson *The Fragile Frontier* 154.

144 Article IV of the *Outer Space Treaty* holds that: "States Parties to the Treaty undertake not to place in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner. The Moon and other celestial bodies shall be used by all States Parties to the Treaty exclusively for peaceful purposes. The establishment of military bases, installations and fortifications, the testing of any type of weapons and the conduct of military manoeuvres on celestial bodies shall be forbidden. The use of military personnel for scientific research or for any other peaceful purposes shall not be prohibited. The use of any equipment or facility necessary for peaceful exploration of the Moon and other celestial bodies shall also not be prohibited".

145 Article VI of the *Outer Space Treaty* 1967.

146 Pusey 2010 *Col J Int'l Env L & Pol'y* 436.

looking only at responsibility for actions and not how harmful actions could be prevented.¹⁴⁷ Holding states responsible for actions such as the creation of space debris would also be very difficult as it is almost impossible to identify the source of most outer space debris.¹⁴⁸ It therefore seems more positive in theory but in reality does not seem to include the responsibility to remedy or clean up space debris. There should thus be a discussion on what this responsibility encompasses and made to be legally binding on states.¹⁴⁹ Responsibility furthermore links to liability,¹⁵⁰ an issue that is seemingly addressed under Article VII which states that:

Each State Party to the Treaty that launches or procures the launching of an object into outer space, including the Moon and other celestial bodies, and each State Party from whose territory or facility an object is launched, is internationally liable for damage to another State Party to the Treaty or to its natural or juridical persons by such object or its component parts on the Earth, in air space or in outer space, including the Moon and other celestial bodies.¹⁵¹

This article under the OST seem to be clear on the aspect of liability for space objects, but in fact similarly to other articles in the OST lacks a clear explanation of the basic terminology needed to enforce this provision. The term “space object” is left legally undefined in the OST and it is unclear if space debris is included within this definition.¹⁵² Some scholars argue that space objects include their component parts and fragments for purposes of international law, and mention that states could be held liable for damages caused by non-functioning spacecraft because ownership can easily be identified.¹⁵³ On the other hand even if space debris is legally seen as part of the main space object launched, the same limitation of identifying the source of the millions of pieces of space debris will make this provision fundamentally just as ineffective as the previous article under

147 Williams 1994 *J Air L & Com* 1153.

148 Williams 1994 *J Air L & Com* 1154.

149 Williamson *The Fragile Frontier* 157.

150 *Liability Convention* 1972.

151 Article VII of the *Outer Space Treaty* 1967.

152 Pusey 2010 *Col J Int'l Env L & Pol'y* 436.

153 Pusey 2010 *Col J Int'l Env L & Pol'y* 436-437.

the OST.¹⁵⁴ Liability furthermore only goes as far as the protection of assets and humans with no reference to the actual protection of the outer space environment itself.¹⁵⁵ Article VIII of the OST refers to ownership and jurisdiction of space objects and states that:

A State Party to the Treaty on whose registry an object launched into outer space is carried shall retain jurisdiction and control over such object...Ownership of objects launched into outer space, including objects landed or constructed on a celestial body, and of their component parts, is not affected by their presence in outer space or on a celestial body or by their return to the Earth.¹⁵⁶

Article VIII may have some significance for the possible removal of space debris in future, meaning that space debris, if interpreted to be a part of “space objects”, will still be under the jurisdiction and ownership of launching states.¹⁵⁷ Article VIII may add to the problem of space debris as it clearly prohibits other states from simply destroying or removing another state’s space objects or component parts without prior permission.¹⁵⁸ This article could be seen as the start of the *Registration Convention* that followed, overriding and regulating most aspects of jurisdiction and control of space objects.¹⁵⁹ However, the article that is considered to be the most important on the subject of environmental consideration is Article IX, it holds that:

In the exploration and use of outer space, including the Moon and other celestial bodies, States Parties to the Treaty shall be guided by the principle of cooperation and mutual assistance and shall conduct all their activities in outer space, including the Moon and other celestial bodies, with due regard to the corresponding interests of all other States Parties to the Treaty. States Parties to the Treaty shall pursue studies of outer space, including the Moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extra terrestrial matter 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

154 Williams 1994 *J Air L & Com* 1154. This article under the OST was later the reason for the creation of the derivative *Liability Convention* which will be discussed further in subsequent parts of this study.

155 Williamson *The Fragile Frontier* 156.

156 Article VIII of the *Outer Space Treaty* 1967.

157 Williams 1994 *J Air L & Com* 1154.

158 Williams 1994 *J Air L & Com* 1164.

159 Williams 1994 *J Air L & Com* 1154.

or its nationals in outer space, including the Moon and other celestial bodies, would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space, including the Moon and other celestial bodies, it shall undertake appropriate international consultations before proceeding with any such activity or experiment. A State Party to the Treaty which has reason to believe that an activity or experiment planned by another State Party in outer space, including the Moon and other celestial bodies, would cause potentially harmful interference with activities in the peaceful exploration and use of outer space, including the Moon and other celestial bodies, may request consultation concerning the activity or experiment.¹⁶⁰

Interestingly this article does refer to environmental protection, but in actuality only does so to maximise the exploitation of outer space and to ensure that planned experiments are done in such a manner as to ensure the possibility of future exploitation and experiments and not for the sake of the outer space environment itself.¹⁶¹ There are also other fundamental problems with this provision. Firstly “harmful contamination” and “harmful interference” is once again left legally undefined and open to interpretation by the user, questioning whether space debris is considered as such.¹⁶² Secondly if space debris is regarded as harmful contamination, at which stage would the creation of outer space debris necessitate consultations, as debris will always be a by-product and will likely interfere with the activities of other states in future? Once again this can be seen as only a procedural requirement for conducting harmful experiments or activities and not as a measure of protecting the outer space environment.¹⁶³ Having said this, states should still have due regard for other states, recognising the interests of other states and should consult with each other, this is known as the duty of due diligence. This article essentially protects humans and assets from harm, insuring the possibility of future studies and data in outer space and protects the earth from contamination from outer space.¹⁶⁴ The remaining articles under the OST do not refer to any significant environmental aspect and only deal with the international cooperation and procedural matters of the treaty.¹⁶⁵

160 Article IX of the *Outer Space Treaty* 1967.

161 Roberts 1992 *BC Int'l & Comp L Rev* 60.

162 Williams 1994 *J Air L & Com* 1155.

163 Pusey 2010 *Col J Int'l Env L & Pol'y* 437.

164 Williamson *The Fragile Frontier* 160.

165 Williamson *The Fragile Frontier* 160.

3.2 *The Liability Convention of 1972*

The *Liability Convention* was adopted in 1971 and opened for signature in 1972, since 2005 it has been ratified by more than 82 countries.¹⁶⁶ South Africa has ratified the *Liability Convention* in September 2009.¹⁶⁷ The *Liability Convention* was drafted by UNCOPUOS to address the inadequacy of article VII of the OST, elaborating on the liability for damage caused by space objects and to provide a guideline for the settlement of claims.¹⁶⁸ The *Liability Convention* as a result, sets out more detailed guidelines with regard to the liability for damages caused by space objects to other state parties and their citizens.¹⁶⁹ The first positive and progressive steps taken in the *Liability Convention* was the attempt to provide definitions for concepts such as “space object”, “damage” and “launching state”.

Article I of the *Liability Convention* states that “space objects” include their component parts as well as its launch vehicle and the parts thereof.¹⁷⁰ Some space debris can, therefore, be considered as “space objects”, but there will still need to be relied on the correct interpretation of this concept by other state parties, as space debris is not explicitly listed here. Article I also defines the concept of launching state, which includes: “(i) A State which launches or procures the launching of a space object and (ii) A State from whose territory or facility a space object is launched.”¹⁷¹ This means that several state parties can be held accountable for damages, including private or state parties that provide financial backing or request the launch of spacecraft, seen as the procurement of space objects.¹⁷² Article IV confirms that these parties are held severally and jointly liable for damages.¹⁷³ Article IV further determines that:

166 Williamson *The Fragile Frontier* 151.

167 Department of foreign affairs 2013 www.dfa.gov.za/foreign/Multilateral/inter/copuos.htm.

168 Williamson *The Fragile Frontier* 151.

169 Viikari *Environmental Element in Space Law* 65.

170 Article I of the *Liability Convention* 1972.

171 Article I of the *Liability Convention* 1972.

172 Viikari *Environmental Element in Space Law* 67.

173 Article IV of the *Liability Convention* holds that: 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, and of damage thereby being caused to a third State or to its natural or juridical

In all cases of joint and several liability referred to in paragraph 1 of this article, the burden of compensation for the damage shall be apportioned between the first two States in accordance with the extent to which they were at fault; if the extent of the fault of each of these States cannot be established, the burden of compensation shall be apportioned equally between them. Such apportionment shall be without prejudice to the right of the third State to seek the entire compensation due under this Convention from any or all of the launching States which are jointly and severally liable.¹⁷⁴

The *Liability Convention* then defines “damage” as “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 organisations”.¹⁷⁵ Clearly, environmental damage to the earth and outer space is not considered here, and pollution will not trigger any state liability in this regard.¹⁷⁶ The *Liability Convention* addresses two forms of liability, firstly absolute/strict liability where damage is done by a space object on earth or to an aircraft in flight, meaning fault does not have to be proven here.¹⁷⁷ This is established by article II, stating that “a launching State shall be absolutely liable to pay compensation for damage caused by its space object on the surface of the Earth or to aircraft in flight”.¹⁷⁸ Secondly, fault based liability¹⁷⁹ is established under article III for damage that occur in outer space, as users of outer space should be aware of the dangers and hazards associated with utilising outer space and should bear some of the risk involved.¹⁸⁰ As fault is not clearly defined in the *Liability Convention*, the ordinary meaning would suggest that a breach of a legal

persons, the first two States shall be jointly and severally liable to the third State, to the extent indicated by the following:

- (a) If the damage has been caused to the third State on the surface of the Earth or to aircraft in flight, their liability to the third State shall be absolute;
- (b) If the damage has been caused to a space object of the third State or to persons or property on board that space object elsewhere than on the surface of the Earth, their liability to the third State shall be based on the fault of either of the first two States or on the fault of persons for whom either is responsible.

174 Article I of the *Liability Convention* 1972.

175 Article IV (2) of the *Liability Convention* 1972.

176 Bressack 2011 *Geo Wash Int'l L Rev* 755.

177 Viikari *Environmental Element in Space Law* 66.

178 Article II of the *Liability Convention* 1972.

179 Article III of the *Liability Convention* holds that: 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.

180 Viikari *Environmental Element in Space Law* 66.

duty is required.¹⁸¹ Unfortunately there is currently no legally recognised standard of care for users of outer space, thus, proving that a legal duty was breached, will fundamentally be very difficult.¹⁸² It is also clear that the creation of space debris has never been seen as a negligent act by states, thus excluding fault liability as a viable way of claiming damages.¹⁸³ Commentators have thus called for the amendment of the *Liability Convention* in order to provide a standard of care and legal duty, thus enabling fault based liability.¹⁸⁴ Although the *Liability Convention* does not directly address issues of space debris, customary international law principles can be investigated to supply a possible solution. The first principle with regard to liability can be found in the *Trail Smelter*¹⁸⁵ arbitration in 1941 where an ore smelting plant in British Columbia, Canada produced tons of hazardous sulphurdioxide fumes causing substantial environmental damage to the State of Washington. The United States Government sought damages from Canada and was successively awarded compensation. The responsibility for transboundary environmental damage was thus clearly established and later found incorporated in principle 21 of the *Stockholm Declaration on the Human Environment* which states that:

States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure the 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.¹⁸⁶

The *Corfu Channel Case*¹⁸⁷ in 1949 also provides an example of a claim for damages between states. In this case British warships were damaged and crew lost due to exploding mines whilst passing through the Corfu Channel in Albanian territorial waters. The International Court of Justice found Albania liable for

181 Bressack 2011 *Geo Wash Int'l L Rev* 757.

182 Bressack 2011 *Geo Wash Int'l L Rev* 743.

183 Bressack 2011 *Geo Wash Int'l L Rev* 744.

184 Bressack 2011 *Geo Wash Int'l L Rev* 744.

185 Bressack 2011 *Geo Wash Int'l L Rev* 744.

186 Principle 21 of the *Declaration of the United Nations Conference on the Human Environment* 1972 (hereafter referred to as the *Stockholm Declaration*).

187 *Corfu Channel Case (United Kingdom v. Albania)* Merits [1949] I.C.J. Rep. 4, 22.

damages under international law for the explosions, damage, and loss of life.¹⁸⁸ Both the *Corfu Channel Case* and *Trail Smelter Arbitration* confirm the international law obligation on states to “not knowingly allow its territory to be used for acts contrary to the rights of other states and that a state owes at all times a duty to protect other States against injurious acts by individuals from within its jurisdiction”.¹⁸⁹ This duty to use due diligence is also extended to private persons and entities under the state’s jurisdiction as they are regarded as agents of a state thus directly responsible if they fail to use due diligence.¹⁹⁰ This might only apply to national jurisdiction but does none the less confirm that states should use due diligence in all actions where they interact with other nations, even in outer space. The fact, however, remains that this does not prevent the creation of new orbital debris and will be similar in practice as article IX of the OST.¹⁹¹ Nonetheless where a claim for damages is successful, the *Liability Convention* guarantees under article XII that:

The compensation which the launching State shall be liable to pay for damage under this Convention shall be determined in accordance with international law and the principles of justice and equity, in order to provide such reparation in respect of the damage as will restore the person, natural or juridical, State or international organization on whose behalf the claim is presented to the condition which would have existed if the damage had not occurred.¹⁹²

Environmental damages are, however, excluded and states do not have to worry much about polluting the outer space, as long as it does not cause damage to the property or persons of other states.¹⁹³ The only article under the *Liability Convention* that can be linked to environmental damages is article XXI stating that:

If the damage caused by a space object presents a large-scale danger to human life or seriously interferes with the living conditions of the population or the functioning of vital centres, the States Parties, and in particular the launching State, shall examine the possibility of rendering appropriate and rapid assistance to the State which has suffered the damage, when it so

188 Taylor *Orbital Debris* 50.

189 Taylor *Orbital Debris* 48.

190 Taylor *Orbital Debris* 48.

191 Taylor *Orbital Debris* 51.

192 Article XII of the *Liability Convention* 1972.

193 Viikari *Environmental Element in Space Law* 69.

requests. However, nothing in this article shall affect the rights or obligations of the States Parties under this Convention.¹⁹⁴

This article only guarantees assistance in these situations and is not clear on responsibility. There seems to be vagueness around most of the important aspects of the *Liability Convention*, making it difficult to apply the principles in even obvious cases where damage is not caused by space debris.¹⁹⁵ Another worrying aspect of the *Liability Convention* is the fact that private citizens are not able to institute claims in their private capacity, as a claim must be formally presented through the correct diplomatic channels by the victim's government.¹⁹⁶ Even more worrying is that the award for damages by the commission under the treaty can only be considered in good faith and is not binding unless parties agree thereto.¹⁹⁷ This will cause many problems in the near future if one considers the current rise of commercial space flight and the involvement of private entities in outer space activities.¹⁹⁸ After considering the *Liability Convention* it is clear that even in normal circumstances, damages arising out of space activities are difficult to prove and it is even more difficult to enforce compensation measures. Outer space pollution and the damage to the outer space environment are not provided for under the convention and will thus require other preventative measures to be implemented in this regard. The *Registration Convention* may aid in the attempt to prevent and compensate for damages caused by space debris in the future.

3.3 The Registration Convention of 1975 and Rescue Agreement of 1968

The *Registration Convention* was opened for signature in January 1975 and entered into force in 1976.¹⁹⁹ By 2010 the *Registration Convention* had been ratified by 54 states, which included Russia, the United States of America, China and even North Korea.²⁰⁰ South Africa ratified the *Registration Convention* in

194 Article XXI of the *Liability Convention* 1972.

195 Viikari *Environmental Element in Space Law* 69.

196 Stayduhar 2006 *Pitts U J Tech L & Pol'y* 10.

197 Stayduhar 2006 *Pitts U J Tech L & Pol'y* 10.

198 Stayduhar 2006 *Pitts U J Tech L & Pol'y* 10.

199 S n chal 2007 www.spacegeneration.org 70.

200 Imburgia 2011 *Vanderbilt Journal of Transnational Law* 618.

2009.²⁰¹ The *Registration Convention*, in essence, requires countries to register all objects launched into outer space and could be seen as an extension of Article VIII of the OST. The *Registration Convention*, similar to the *Liability Convention* reaffirms that states bear international responsibility for their national activities in outer space. Notable from the *Registration Convention* is that the same definitions of “launching state” and “space object” found in the *Liability Convention* are used, most likely due to the fact that they are meant to work in conjunction with each other. This, however, limits the scope of its application in the same way as the *Liability Convention*.²⁰² Primarily the *Registration Convention*, under article II, requires a launching state to “register the space object by means of an entry in an appropriate registry which it shall maintain and to inform the Secretary-General of the United Nations of the establishment of such a registry”.²⁰³ Clearly the first problem this requirement creates is that a registry will be very difficult to maintain where there are several states or multinational space missions involved in launching an object. Even so, each national registry must then be provided to the Secretary-General where the UN further creates one registry which is made available to the public.²⁰⁴ Article IV of the *Registration Convention* requires that states provide the following information:

- (a) Name of launching State or States;
- (b) An appropriate designator of the space object or its registration number;
- (c) Date and territory or location of launch;
- (d) Basic orbital parameters, including:
 - (i) Nodal period;
 - (ii) Inclination;
 - (iii) Apogee;
 - (iv) Perigee;

201 Department of foreign affairs 2013 www.dfa.gov.za/foreign/Multilateral/inter/copuos.htm.

202 Viikari *Environmental Element in Space Law* 75; “Launching state” is defined as a state which launches or procures the launching of a space object and a state from whose territory or facility a space object is launched and “space object” includes component parts of a space object as well as its launch vehicle and parts thereof.

203 Article II of the *Registration Convention* 1975.

204 Akers 2012 *U La Verne L Rev* 305.

(e) General function of the space object.²⁰⁵

Looking at the requirements for the registry, the *Registration Convention* lacks clarity on a range of aspects, especially with regard to space debris. It is clear that any information regarding the creation of space debris and possible environmental damage associated with the launch of the space object is irrelevant to the registry. This means that other states will not be able to evaluate any risks posed by other launches and cannot anticipate any damage that might occur as a result of a new launch and its debris.²⁰⁶ States are also allowed to provide the information at their own discretion and are not required to update any information once the information is listed in the merged registry.²⁰⁷ States may from time to time provide the United Nations with additional information regarding a space object.²⁰⁸ There is also no deadline for the registration of space objects as the convention only requires states to do so “as soon as practicable”.²⁰⁹ Even so, many objects are launched without any registry, either by companies registering under countries that are not party to the treaty, launching from international waters or to simply abstain from registering objects to hide the fact that they are used for military purposes.²¹⁰

Space objects are also sold or leased between states, meaning states that are registered may no longer be in control of certain space objects.²¹¹ An estimated one-third of objects are not registered and only half of re-entries are reported to the UN.²¹² This happens due to the fact that there is no enforcement mechanism with penalties created under the *Registration Convention* and, therefore, also hinders the possibility of later utilising the *Liability Convention* to claim

205 Article IV of the *Registration Convention* 1975; “Inclination refers to the incline of the orbit with polar orbit being ninety degrees and equatorial orbit set at zero degrees. Apogee is the highest altitude that the object will travel above Earth’s surface; this number is measured in kilometres. Perigee is the lowest altitude that the launched object will travel above the Earth’s surface and is also measured in kilometres” - Akers 2012 *U La Verne L Rev* 306.

206 Akers 2012 *U La Verne L Rev* 306.

207 Akers 2012 *U La Verne L Rev* 305.

208 Article IV of the *Registration Convention* 1975.

209 Article IV of the *Registration Convention* 1975.

210 Akers 2012 *U La Verne L Rev* 307.

211 Viikari *Environmental Element in Space Law* 77.

212 Viikari *Environmental Element in Space Law* 75.

damages.²¹³ One of the only articles under the *Registration Convention* with a clear obligation towards identification of space objects, states that:

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, including in particular States possessing space monitoring and tracking facilities, shall respond to the greatest extent feasible to a request by that State Party, or transmitted through the Secretary-General on its behalf, for assistance under equitable and reasonable conditions in the identification of the object. A State Party making such a request shall, to the greatest extent feasible, submit information as to the time, nature and circumstances of the events giving rise to the request. Arrangements under which such assistance shall be rendered shall be the subject of agreement between the parties concerned.²¹⁴

This does create a duty to share information and to assist countries to identify space objects that caused damage in normal circumstances, but is theoretically not intended to include space debris and will likely not provide much assistance in these situations.²¹⁵ It is clear that more sophisticated requirements are necessary under the *Registration Convention*, especially with regard to space debris. States may decide to provide and share such information voluntarily, but the current trend seems to indicate that this will not be happening unless it is universally required.

The *Rescue Agreement* entered into force in 1968 and deals specifically with “assistance to astronauts in the event of an accident, distress or emergency landing, the prompt and safe return of astronauts, and the return of objects launched into outer space.”²¹⁶ South Africa has also ratified the *Rescue Agreement*.²¹⁷ Under the *Rescue Agreement*, states are required to notify the UN and launching state when they receive information or discover that a space object has returned to earth; even if damage was not done to an area within their national jurisdiction.²¹⁸ The *Rescue Agreement* might not seem to be directly

213 Akers 2012 *U La Verne L Rev* 307.

214 Article IV of the *Registration Convention* 1975.

215 Imburgia 2011 *Vanderbilt Journal of Transnational Law* 620.

216 Preamble to the *Rescue Agreement* 1968.

217 Department of foreign affairs 2013 www.dfa.gov.za/foreign/Multilateral/inter/copuos.htm.

218 Article 5(1) of the *Rescue Agreement* 1968.

applicable to space debris, but environmental hazards may establish the need for rescue or the return/removal of an object launched into outer space. Article 5(4) of the *Rescue Agreement* holds that:

Notwithstanding paragraphs 2 and 3 of this article, a Contracting Party which has reason to believe that a space object or its component parts discovered in territory under its jurisdiction, or recovered by it elsewhere, is of a hazardous or deleterious nature may so notify the launching authority, which shall immediately take effective steps, under the direction and control of the said Contracting Party, to eliminate possible danger of harm.²¹⁹

Article 5(4) may solve the problem of removing space debris and jurisdictional issues, but seemingly still relies on the notification and action of the launching state. *Williams* refers to the possibility that there is no limitation on removing space debris as it cannot be traced back to the launching state and is, therefore, in essence not limited or governed by the space treaties.²²⁰ Unlike the other space treaties that refer to a launching state, the *Rescue Agreement* refers to a launching authority and states that:

For the purposes of this Agreement, the term “launching authority” shall refer to the State responsible for launching, or, where an international intergovernmental organization is responsible for launching, that organization, provided that that organization declares its acceptance of the rights and obligations provided for in this Agreement and a majority of the States members of that organization are Contracting Parties to this Agreement and to the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies.²²¹

Intergovernmental organisations are, therefore, acknowledged as launching authorities, but then again there is no mention of private companies being regarded as launching authorities. Even so, the *Rescue Agreement* lacks clarity on terminology such as “elsewhere” and questions such as if space debris classifies as a space object of hazardous or deleterious nature. It is also unclear which threats may constitute a request to take action, or even when states may unilaterally take action to remove such threats. *Viikari* argues that after notification and consultation have failed and the space object has not been removed within a

219 Article 5(4) of the *Rescue Agreement* 1968.

220 *Williams* 1994 *J Air L & Com* 1165.

221 Article 6 of the *Rescue Agreement* 1968.

reasonable time, the state in danger will have the right to remove or destroy such an object if necessary.²²² The removal of space debris is currently very difficult as technology in this regard is still new and economically unfeasible.²²³ Article 5(5) of the *Rescue Agreement* however states that:

Expenses incurred in fulfilling obligations to recover and return a space object or its component parts under paragraphs 2 and 3 of this article shall be borne by the launching authority.²²⁴

This could, therefore, be argued to also extend to situations where a launching state fails to address an emergency situation or threat and the endangered state takes the necessary steps to prevent such damage from occurring. It is clear that the *Rescue Agreement* does more to address space debris than most of the “main” outer space treaties, and could be one of the most essential treaties in the coming decades if space debris is not addressed.

3.4 The Moon Agreement of 1979

The *Moon Agreement* was adopted in 1979 and came into force in July 1984. It has not been widely accepted and the major space-faring states as well as South Africa are not parties to this agreement.²²⁵ Only 13 states had ratified the agreement by 2010 and its provisions have, therefore, not become customary international law.²²⁶ Nonetheless, it still remains important for the purposes of academic reasons as well as this study since it elaborates on article XI of the OST and directly refers to the environmental protection of celestial bodies and the outer space environment.²²⁷

The *Moon Agreement* under article 11(1) directly states that the Moon and its natural resources are the common heritage of mankind and incorporates all characteristics of the common heritage of mankind principle, these include that:

222 Viikari *Environmental Element in Space Law* 83.

223 Viikari *Environmental Element in Space Law* 83.

224 Article 5(5) of the *Rescue Agreement* 1968.

225 Taylor *Orbital Debris* 40.

226 Taylor *Orbital Debris* 40.

227 Williamson *The Fragile Frontier* 151.

- a) activities shall be carried out in accordance with international law,²²⁸
- b) the Moon shall be used by all states exclusively for peaceful purposes,²²⁹
- c) the Moon is not subject to national appropriation by any claim of sovereignty,
- d) by means of use or occupation, or by any other means,²³⁰
- e) weapons and all military activities are therefore strictly forbidden,²³¹
- f) the Moon shall be the province of all mankind and used in the interests of all countries - irrespective of their degree of economic or scientific development,²³² mutual assistance and cooperation between states,²³³
- g) Equitable access and sharing of benefits²³⁴ and international responsibility for national activities in outer space²³⁵

Interestingly and unlike the OST or other related outer space treaties the *Moon Agreement* directly refers to environmental protection under article 7(1), stating 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 extra-terrestrial matter or otherwise.²³⁶

It is clear that progress was made with regard to environmental protection in succeeding the earlier outer space treaties, moving away from simply referring only to “harmful contamination”.²³⁷ It is also important to note that these measures can also be applied to other celestial bodies as article 1 of the *Moon Agreement* states that:

228 Article 2 of the *Moon Agreement* 1979.
 229 Article 3(1) of the *Moon Agreement* 1979.
 230 Article 11(2) of the *Moon Agreement* 1979.
 231 Article 3(2)-(4) of the *Moon Agreement* 1979.
 232 Article 4(1) of the *Moon Agreement* 1979.
 233 Article 4(2) of the *Moon Agreement* 1979.
 234 Article 11(4) and (7) of the *Moon Agreement* 1979.
 235 Article 14(1) of the *Moon Agreement* 1979.
 236 Article 7(1) of the *Moon Agreement* 1979.
 237 Viikari *Environmental Element in Space Law* 62.

The provisions of this Agreement relating to the Moon shall also apply to other celestial bodies within the solar system, other than the Earth, except insofar as specific legal norms enter into force with respect to any of these celestial bodies.²³⁸

It is clear that this agreement has attempted to provide the means to preserve the outer space environment. However, in reality this does little to change the current situation as it suffers from the identical lack of clarity with regard to important definitions such as “harmful” and whether or not space debris can be viewed as such.²³⁹ More importantly, even if space debris is considered as harmful and disruptive to the environment, the *Moon Agreement* still remains ineffective due a fatal lack of appropriate sanctions and adherents.²⁴⁰ It therefore only remains important to the study as it shows that the global community has noted the current and future adverse effects space exploration will have on the outer space environment and that protection is necessary. Further preventative steps are provided for under article 7(2) of the *Moon Agreement*, stating that:

States Parties shall inform the Secretary-General of the United Nations of the measures being adopted by them in accordance with paragraph 1 of this article and shall also, to the maximum extent feasible, notify him in advance of all placements by them of radioactive materials on the Moon and of the purposes of such placements.²⁴¹

The *Moon Agreement*, therefore, unlike other outer space treaties, requires preventative steps to be taken, associated with environmental principles such as the precautionary principle, sustainability and intergenerational equity to be discussed in the subsequent sections of this study. The *Moon Agreement* also requires states to warn the international community of “any phenomena they discover in outer space, including the Moon, which could endanger human life or health, as well as of any indication of organic life”.²⁴² This requirement can, however, be interpreted to be more of a scientific consideration towards the protection of life on earth than a step towards protecting the indigenous life and

238 Article 1 of the *Moon Agreement* 1979.

239 The similar lack of clarity with regard to definitions can be found in the *Liability Convention*.

240 Viikari *Environmental Element in Space Law* 62.

241 Article 7(2) of the *Moon Agreement* 1979.

242 Article 5(3) of the *Moon Agreement* 1979.

environment on other celestial bodies.²⁴³ Under article 7(3) of the *Moon Agreement* steps can be taken to protect and preserve certain designated areas on the Moon or even other celestial bodies, even though it is clearly done for scientific reasons and not conservation as such.²⁴⁴ Article 8 of the *Moon Agreement* confirms that the environmental protection is most likely done for scientific purposes, as:

1. States Parties may pursue their activities in the exploration and use of the Moon anywhere on or below its surface, subject to the provisions of this Agreement.
2. For these purposes States Parties may, in particular:
 - (a) Land their space objects on the Moon and launch them from the Moon;
 - (b) Place their personnel, space vehicles, equipment, facilities, stations and installations anywhere on or below the surface of the Moon. Personnel, space vehicles, equipment, facilities, stations and installations may move or be moved freely over or below the surface of the Moon.²⁴⁵

These activities will clearly have an adverse effect on the Moon or other celestial bodies. Having said this, article 9 therefore states that where a station is based on the Moon or possibly other celestial bodies, a state party shall only use that area which is required for the needs of the station, indicating the necessity for preservation rather than uncontrolled exploitation.²⁴⁶ From examining the *Moon Agreement*, it is clear that many positive steps are taken to preserve the outer space environment. However, it is wholly inapplicable due to the lack of ratification, not to mention that it does not even apply to private or non-state enterprises. According to Williamson, the *Moon Agreement* was “manna from heaven for environmentalists and a testament from hell for the developers” as the Moon will remain the common heritage of mankind, prohibiting economic exploitation.²⁴⁷ Therefore, the *Moon Agreement* acts as nothing more than an example of the level of protection necessary to insure the sustainability of the outer space environment.

243 Williamson *The Fragile Frontier* 163.

244 Article 7(3) of the *Moon Agreement* 1979.

245 Article 8(1)-(2) of the *Moon Agreement* 1979.

246 Article 9(1) of the *Moon Agreement* 1979.

247 Williamson *The Fragile Frontier* 166.

3.5 The United Nations Space Debris Mitigation Guidelines

3.5.1 Historical overview

When considering the preceding agreements and treaties, it is clear that space debris was not truly considered a major concern up until the late 1970's when references to environmental protection started to surface in the *Moon Agreement* and other technical papers, studies and reports on space debris.²⁴⁸ Since the 1980's many authoritative studies and reports were undertaken on a global scale by entities such as the European Space Agency (ESA), the United States National Security Council, the Congress Office of Technology Assessment of the United States, COSPAR and the International Academy of Astronautics.²⁴⁹ The formal founding of the UN space debris mitigation guidelines is, however, credited to the Inter-Agency Space Debris Coordination Committee (IADC) established in 1993.²⁵⁰ The IADC as discussed previously²⁵¹ is a multi-national agency comprising of space agencies from around the world concerned with all matters associated with space debris.

In 1994 UNCOPUOS considered for the first time, on a priority basis, matters associated with space debris.²⁵² This was the start of the first multi-year work plan by the Scientific and Technical Subcommittee working in collaboration with the IADC to publish the Technical Report on Space Debris of 1999.²⁵³ This report succeeded in bringing the attention of the world to space debris, but failed to define space debris in a universally approved manner and to convey the necessary message of urgency regarding this problem.²⁵⁴ The Scientific and Technical Subcommittee, therefore, proceeded to establish a second multi-year workplan from 2002 up until 2005 that would see countries moving towards

248 Hobe and Mey 2009 *Zeitschrift für Luft- und Weltraumrecht* 388.

249 Hobe and Mey 2009 *Zeitschrift für Luft- und Weltraumrecht* 388.

250 Hobe and Mey 2009 *Zeitschrift für Luft- und Weltraumrecht* 391.

251 See page 14 of this dissertation.

252 Preface of the *United Nations Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space* (2010).

253 Hobe and Mey 2009 *Zeitschrift für Luft- und Weltraumrecht* 391.

254 Hobe and Mey 2009 *Zeitschrift für Luft- und Weltraumrecht* 391.

voluntary debris mitigation measures.²⁵⁵ At the same time the IADC was already developing its own space debris mitigation guidelines, which were submitted to the Scientific and Technical Subcommittee in 2003 in an attempt to address this problem practically.²⁵⁶ From 2004 the Subcommittee started to endorse the mitigation guidelines suggested by the IADC and requested that states start to implement these guidelines on a voluntary basis through their own national mechanisms.²⁵⁷ After review of these guidelines, the Subcommittee received negative feedback from certain states and discovered that these guidelines did not consider or correspond to some of the mitigation practices that some states were practicing and needed review.²⁵⁸ Another multi-year workplan from 2005 until 2007 was established where the IADC mitigation guidelines would be developed into a new document under UNCOPUOS.²⁵⁹ The following guidelines were laid down for this new document:

- a) It would use the technical content of the Inter-Agency Space Debris Co-ordination Committee space (A/AC.105/C.1/L.260) as the basis;
- b) It would not be more technically stringent than the Inter-Agency Space Debris Coordination Committee space debris mitigation guidelines;
- c) It would not be legally binding under international law;
- d) The implementation of space debris mitigation remains voluntary and should be carried out through national mechanisms;
- e) It would recognize that exceptions might be justified;
- f) It would be a living document that could be updated on a regular basis in accordance with evolving national and international practices on space debris mitigation and related research and technology developments;
- g) It would be applicable to mission planning, to the operation of newly designed spacecraft and orbital stages and, if possible, to existing ones;
- h) It would take into consideration the United Nations treaties and principles on outer space;

255 Preface of the *United Nations Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space* (2010).

256 Hobe and Mey 2009 *Zeitschrift für Luft- und Weltraumrecht* 391.

257 Preface of the *United Nations Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space* (2010) – Catalogues kept by the US and Russia conflicted and had to be reconciled.

258 Preface of the *United Nations Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space* (2010).

259 Preface of the *United Nations Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space* (2010).

- i) The space debris mitigation document is planned to be a concise document containing high-level qualitative guidelines and making reference to the Inter-Agency Space Debris Coordination Committee space debris mitigation guidelines. The document will have annexes as decided by the Working Group during its work plan.²⁶⁰

After revision, new guidelines were submitted to the General Assembly and officially adopted in 2007.²⁶¹ As from 2007 the *Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space* were officially endorsed as they now reflected the existing practices of most national and international organisations. However, the question that remained was if these guidelines would have any noticeable impact on the existing practices of member states?

3.5.2 Assessment of the United Nations Space Debris Mitigation Guidelines

The 2007 *Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space* seemingly comprises of seven clear guidelines to mitigate space debris. In the following discussion it will, on the contrary, become clear that this directive only offers very basic guidance and will most likely be insufficient to address the problem of outer space pollution essentially. Before the seven guidelines can be discussed it is important to note that the first internationally accepted definition for space debris was drafted by the IADC and later incorporated in this guideline document. This is significant considering the fact that the Scientific and Technical Subcommittee drafted these guidelines and not the Legal Subcommittee. This will become evident as these guidelines are discussed further.

Defining space debris does aid in the effort to address space debris, but as the discussion will show has little effect due to the fact that these guidelines will most likely be ineffective. The first major problem with these guidelines is the fact that they are not legally binding under international law and many academics agree that without rigorous adherence these mitigation guidelines will be

260 Hobe and Mey 2009 *Zeitschrift für Luft- und Weltraumrecht* 392-393.

261 Preface of the *United Nations Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space* (2010).

unsuccessful.²⁶² The guidelines contain phrases such as “implementation is recommended”, “should voluntarily take measures” and explicitly state that they are “not legally binding”.²⁶³ This is problematic since most agree that the only solution to this problem will be legal and political action on a national and international scale to encourage the protection of the outer space environment.²⁶⁴ The rationale behind these guidelines is also worrying as it states that: “space debris has the potential to damage spacecraft, leading to loss of mission, or loss of life in the case of manned spacecraft”.²⁶⁵ There is clearly no mention of safety, security, economic, environmental or equity concerns that directly reflects the views at the beginning of the space era.²⁶⁶ Nonetheless the following guidelines are provided:

- 1) Limit debris released during normal operations;²⁶⁷
- 2) Minimise the potential for break-ups during operational phases;²⁶⁸
- 3) Limit the probability of accidental collision in orbit;²⁶⁹
- 4) Avoid intentional destruction and other harmful activities;²⁷⁰
- 5) Minimise potential for post-mission break-ups resulting from stored energy;²⁷¹

262 Pusey 2010 *Col J Int'l Env L & Pol'y* 434.

263 Hobe and Mey 2009 *Zeitschrift für Luft- und Weltraumrecht* 395.

264 Pusey 2010 *Col J Int'l Env L & Pol'y* 434.

265 Rationale in the United Nations Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space (2010).

266 Hobe and Mey 2009 *Zeitschrift für Luft- und Weltraumrecht* 396.

267 Space systems should be designed to release the least amount of debris during normal operations and if not possible, space debris must be minimised. This can be done by improving the design of space objects.

268 Accidental break-ups due to failure should be avoided during the launch and orbital stages, where failure can be prevented, disposal and passivation measures must be taken. Passivation is the elimination of all stored energy on a spacecraft or orbital stages to reduce the chance of break-up.

269 Collisions with other objects should be estimated and limited, where a collision is anticipated avoidance measures must be taken.

270 Intentional destruction of any space object should be avoided, where necessary they must be conducted at sufficiently low altitudes to limit the orbital lifetime of resulting fragments.

271 All on-board sources of stored energy should be depleted or made safe when they are no longer required for mission operations or post-mission disposal.

- 6) Limit the long-term presence of spacecraft and launch vehicle orbital stages in the low-Earth orbit (LEO) region after the end of their mission;²⁷²
- 7) Limit the long-term interference of spacecraft and launch vehicle orbital stages with the geosynchronous Earth orbit (GEO) region after the end of their mission.²⁷³

There are positive and negative sides to using soft law/non-treaty agreements, but most academics agree that in this situation a review and reinforcement of outer space treaties should take place and that soft law will not be sufficient.²⁷⁴ Some commentators also believe that even if these mitigation guidelines did form part of a binding treaty, they would still do little to limit space debris and would have been difficult to enforce considering the flexible language used.²⁷⁵ More importantly, if any measures were to be made applicable and enforceable on private companies any mitigation codes of conduct, guidelines and treaties should be adopted into domestic law.²⁷⁶ Furthermore, the mitigation guidelines did not provide any steps for remediation or ways to address the financial burden created in possibly removing space debris. This is important as many believe that mitigation alone will not be sufficient.²⁷⁷ There is also no mention of liability or responsibility for non-compliance and no guidance is given in ways to share important information.²⁷⁸ Moreover, the deliberate destruction of space objects, a major cause of space debris, is not prohibited and should only be avoided according to these guidelines. Having said this, it is clear that there are many shortcomings to be found in these guidelines but then again, it should be valued for attempting to address this problem. These guidelines have seemingly succeeded in igniting a trend among member states to implement their own mitigation rules and principles, reflecting a

272 Non-functional spacecraft should be removed from orbit, if not possible they must be disposed of in orbits away from the LEO.

273 Non-functioning space objects in the GEO should be left in orbits that do not interfere with the GEO region.

274 Soft law will negatively contribute as: "Non-treaty agreements are not binding and cannot be enforced; the negotiation process through consensus may not be simpler or more efficient; and Non-treaty agreements may contribute to the incoherence and fragmentation of the international legal system" – Goh 2009 *Neb L Rev* 734.

275 Beck 2009 *AI LJ Scie & Tech* 34.

276 Beck 2009 *AI LJ Scie & Tech* 35.

277 Hobe and Mey 2009 *Zeitschrift für Luft- und Weltraumrecht* 394.

278 Hobe and Mey 2009 *Zeitschrift für Luft- und Weltraumrecht* 394.

desire to address this problem.²⁷⁹ Some of the national mitigation efforts that have been taking place include: the *European Code of Conduct on Space Debris* in 2004, the *United States National Space Policy* of 2010, *NASA's Procedural Requirements for limiting Orbital Debris* and *China's Space activities in 2006* paper.²⁸⁰

The fact, therefore, remains that current outer space law lacks clear language concerning space debris and that the *Liability Convention* and other treaties should be amended or developed further to incorporate orbital debris, providing clear obligations as well as consequences for non-compliance.²⁸¹ The *International Interdisciplinary Congress on Space Debris* in its 2011 report acknowledged the fact that international space law is not sufficient and appropriate to regulate space debris effectively.²⁸² It therefore remains the responsibility of states to adopt these guidelines through their own domestic policies, laws and regulations as they are more easily enforced and will have binding nature.²⁸³ After examining the most important international instruments it is necessary to determine the extent to which South Africa has provided for the regulation of outer space debris, if any.

4 South Africa's national legal framework

Although South Africa is not globally regarded as a major space fairing nation, all member states agree that developing nations such as South Africa should find

279 Bressack 2011 *Geo Wash Int'l L Rev* 776.

280 A Report of the International Interdisciplinary Congress on Space Debris 2011 *Towards Long-Term Sustainability of Space Activities: Overcoming the Challenges of Space Debris* Forty-Eight Session Vienna 21.

281 Bressack 2011 *Geo Wash Int'l L Rev* 776 and A Report of the International Interdisciplinary Congress on Space Debris 2011 *Towards Long-Term Sustainability of Space Activities: Overcoming the Challenges of Space Debris* Forty-Eight Session Vienna 25.

282 A Report of the International Interdisciplinary Congress on Space Debris 2011 *Towards Long-Term Sustainability of Space Activities: Overcoming the Challenges of Space Debris* Forty-Eight Session Vienna 5.

283 A Report of the International Interdisciplinary Congress on Space Debris 2011 *Towards Long-Term Sustainability of Space Activities: Overcoming the Challenges of Space Debris* Forty-Eight Session Vienna 30.

ways to engage in efforts to mitigate space debris.²⁸⁴ This will become imperative as South Africa transitions into a knowledge based economy with the aim to become the leading provider of outer space services in Africa. Developing nations are encouraged to participate in efforts to address space debris as they also risk losing valuable space assets, equitable access to outer space and must insure public safety within their own jurisdiction.²⁸⁵ It is firstly important to examine the current space programme in South Africa briefly and to establish the role that South Africa has been playing in the outer space sector on a global scale.

4.1 South Africa's space programme and participation in international outer space matters

Unlike many other African countries, South Africa has a rich history in the space sector dating back to 1950's with the South African Interplanetary Society in Johannesburg and other groups formed by amateur enthusiasts.²⁸⁶ From those early endeavours South Africa continued to develop various missile and other military projects throughout the Apartheid Era, ending military space developments with the establishment of democracy in South Africa in 1994.²⁸⁷ Some of the space infrastructure left by the Apartheid Era include: The Materials Science & Manufacturing Unit, the National Laser Centre, the Satellite Applications Centre (SAC), the Institute of Satellite and Software Applications with facilities for satellite integration, the Overberg Test Range with three launch pads and many other research and development facilities around South Africa.²⁸⁸ Since 1995 under the Department of Trade and Industry, South Africa has launched two micro-satellites *Sunsat* (1999) and *Sumbandila* (2009) used for Earth observation.²⁸⁹ These satellites only lasted for a short amount of time, but have

284 A Report of the International Interdisciplinary Congress on Space Debris 2011 *Towards Long-Term Sustainability of Space Activities: Overcoming the Challenges of Space Debris* Forty-Eight Session Vienna 36.

285 A Report of the International Interdisciplinary Congress on Space Debris 2011 *Towards Long-Term Sustainability of Space Activities: Overcoming the Challenges of Space Debris* Forty-Eight Session Vienna 36.

286 Gottschalk 2010 *Astropolitics* 2.

287 Gottschalk 2010 *Astropolitics* 2.

288 Gottschalk 2010 *Astropolitics* 4-5.

289 Gottschalk 2010 *Astropolitics* 7.

since provided invaluable experience to micro-satellite manufacturers in South Africa.²⁹⁰ These non-functional satellites have, therefore, added to the amount of space debris in outer space or have since burned up in the atmosphere.

The South African space industry currently employs an estimated 180 – 200 personnel with an annual budget of about 48 to 80 million ZAR.²⁹¹ The South African space industry through major astronomy projects such as the Southern African Large Telescope (SALT) and the Square Kilometre Array Radio Telescope (SKA) is set to grow immensely.²⁹² With the South African National Space Agency (SANSA), a fully established space agency, South Africa is now involved with a number of national and international space activities.²⁹³ SANSA established the National Space Programme (NSP) consisting of these various space activities that will *inter alia* lead to the development, launch and operation of Earth observation satellites for the purposes of “resource management, environmental management, disaster management, planning and decision-making as well as research and development in earth observation”.²⁹⁴ The regulation of national space activities is, however, fragmented and efforts are most likely duplicated due to various different governmental departments tasked to administer parallel space activities.²⁹⁵ The Department of Trade and Industry, the Department of Science and Technology and the Department of Rural Development and Land Reform all have similar legislative mandates with regard to Earth observation, leading to said fragmentation.²⁹⁶ Internationally South Africa is a co-chair and founding member of the Group on Earth Observations (GEO), charged with the implementation of the Global Earth Observation System of Systems (GEOSS) and a key role-player

290 Sekhula 2013 SAJG 140.

291 Gottschalk 2010 *Astropolitics* 8.

292 September 2013 *Fifty-second session of the Legal-Subcommittee on the peaceful use of outer space* –4.

293 September 2013 *Fifty-second session of the Legal-Subcommittee on the peaceful use of outer space* –1.

294 Sekhula 2013 SAJG 140.

295 Sekhula 2013 SAJG 140.

296 Sekhula 2013 SAJG 141.

in bridging the gap between developed and developing countries with regard to information sharing and advancement in this field.²⁹⁷

South Africa has also actively participated in regional and international agreements regarding outer space matters, working together with UNCOPUOS, the African Union's Ministerial Council on Science and Technology as well as inter-agency cooperation in Africa and the rest of the world.²⁹⁸ South Africa in cooperation with other African countries such as Algeria, Kenya and Nigeria are actively developing the African Resource Management Constellation (ARMC), a project to develop and operate a constellation of Earth observation satellites.²⁹⁹ South Africa, therefore, has the responsibility to prepare for and prevent matters of international concern such as space debris. South Africa made the following statement at the 50th session of the Scientific and Technological Subcommittee in February 2013:

The increase of space debris is also a matter of concern for my delegation due to its risk of endangering future exploration and sustainable environment for the use of outer space. South Africa in its regulatory practises is implementing the UN space debris mitigation guidelines.³⁰⁰

As a leader on the African continent it will be important that South Africa leads the way in responsibly utilising the outer space and must then take these necessary legislative steps to insure same.

4.2 South African outer space legislation

The South African regulatory framework regarding outer space activities comprises of a collection of acts, regulations and strategies. South Africa functions on a dualistic system with regard to international law, meaning that treaty obligations do not automatically form part of the domestic legal

297 Mabhongo X 2013 Fiftieth session of the Scientific and Technological Subcommittee – Agenda Item 3: General exchange of views 3.

298 Gottschalk 2010 *Astropolitics* 10.

299 September 2013 *Fifty-second session of the Legal-Subcommittee on the peaceful use of outer space* –4.

300 Mabhongo 2013 *Fiftieth session of the Scientific and Technological Subcommittee* 2-3.

framework.³⁰¹ International customary law is, however, considered to be law in South Africa, except where those provisions are contrary to the provisions of the *Constitution*.³⁰² The following national instruments regulating the use of outer space will be discussed in further detail: The *Space Affairs Act*,³⁰³ the *Space Affairs Amendment Act*,³⁰⁴ the *National Space Agency Act*³⁰⁵ and the *National Space Policy*³⁰⁶ published in 2008.³⁰⁷ The *Space Affairs Act* as amended by the *Space Affairs Amendment Act* is seen as the primary framework for the regulation of outer space activities in South Africa.³⁰⁸ South Africa has, however, admitted that the *Space Affairs Act* as amended does not address issues adequately in an increasingly commercialised space environment and could require further amendments.³⁰⁹ The *Act* firstly contains a range of definitions such as: "outer space"³¹⁰, "space activities"³¹¹, "spacecraft"³¹² and "launching"³¹³. There is, however, no reference to space debris or any related terminology. Section 2 of the *Act* provides the opportunity for South Africa to meet international obligations regarding outer space debris mitigation, stating that:

301 S 231(4) of the Constitution:

Any international agreement becomes law in the Republic when it is enacted into law by national legislation; but a self-executing provision of an agreement that has been approved by Parliament is law in the Republic unless it is inconsistent with the Constitution or an Act of Parliament.

302 S 231(2) of the Constitution of the Republic of South Africa, 1996.

303 *Space Affairs Act* 84 of 1993.

304 *Space Affairs Amendment Act* 64 of 1995.

305 *National Space Agency Act* 21 of 2007.

306 *National Space Policy* of 2008.

307 Other related instruments include: The South African *Spatial Data Infrastructure Act* (54 of 2003); *Disaster Management Act* (57 of 2002); *Independent Communications Authority of South Africa Act* (Act 13 of 2000); *Broadcasting Act* (1999) and the *Electronic Communications Act* (36 of 2005).

308 Hereafter referred to as the *Act*.

309 September 2013 *Fifty-second session of the Legal-Subcommittee on the peaceful use of outer space* –3.

310 "Outer space" means the space above the surface of the earth from a height at which it is in practice possible to operate an object in an orbit around the earth – S1 of the *Space Affairs Act* 1993

311 "Space activities" means the activities directly contributing to the launching of spacecraft and the operation of such craft in outer space– S1 of the *Space Affairs Act* 1993.

312 "Spacecraft" means any object launched with the purpose of being put and operated in outer space – S1 of the *Space Affairs Act* 1993.

313 "Launching" means the placing or attempted placing of any spacecraft into a sub- orbital trajectory or into outer space, or the testing of a launch vehicle or spacecraft in which it is foreseen that the launch vehicle will lift from the earth's surface – S1 of the *Space Affairs Act* 1993.

The Minister may, by notice in the Gazette, determine the general policy to be followed with a view to –

- (a) meeting all the international commitments and responsibilities of the Republic in respect of the peaceful utilization of outer space, in order to be recognized as a responsible and trustworthy user of outer space; and
- (b) controlling and restricting the development, transfer, acquisition and disposal of dual-purpose technologies, in terms of international conventions, treaties and agreements entered into or ratified by the Government of the Republic.³¹⁴

The *Act* further established the South African Council for Space Affairs, tasked with implementing these policies and to “take care of the interests, responsibilities and obligations of the Republic regarding its space and space-related activities in compliance with international conventions, treaties and agreements entered into or ratified by the Government of the Republic.”³¹⁵ The council must also supervise and implement matters arising from international conventions, treaties and agreements concerning space affairs. This would include matters associated with mitigating space debris.³¹⁶ The council is also responsible for the issuing of licences under section 11 of the *Act*, which is required for:

- a) any launching from the territory of the Republic;
- b) any launching from the territory of another state by or on behalf of a juristic person incorporated
- c) or registered in the Republic;
- d) the operation of a launch facility;
- e) the participation by any juristic person incorporated or registered in the Republic, in space activities -
 - (i) entailing obligations to the State in terms of international conventions, treaties or agreements entered into or ratified by the Government of the Republic; or
 - (ii) which may affect national interests;
- f) any other space or space-related activities prescribed by the Minister.³¹⁷

Before the council may award licences, the council must also take into consideration minimum safety standards, national interest and most importantly,

314 S 2(1)(a) of the *Space Affairs Act* 1993.

315 Ss 4-5 of the *Space Affairs Act* 1993.

316 S 5(3)(c) of the *Space Affairs Act* 1993.

317 S 11(1)(a)-(f) of the *Space Affairs Act* 1993.

international obligations and responsibilities.³¹⁸ These licenses may also be revoked, amended or suspended under section 13 of the *Act*. The Council may also order the licensee to take remedial steps where the licensee has not complied with requirements laid down by the council.³¹⁹ Section 14 of the *Act* contains the duties and liabilities of the licensee in addition to the license conditions and holds that a licensee remains liable for damages; the licensee must provide security for damages and, interestingly, is held liable for international conventions, treaties and agreements entered into or ratified by the Government.³²⁰ It can, therefore, be argued that a license holder in the Republic should be aware and abide by agreements such as space debris mitigation. The *Act* also provides for regulations to be made in order to comply with international agreements entered into by the Government.³²¹ This means that mitigation guidelines could form part of comprehensive regulations to the *Act* with or without amending the *Act* itself.

The licensee is held liable for damages that “may be caused (whether or not such licensee is at fault) by a launch vehicle or spacecraft or anything on or in such a launch vehicle or spacecraft, or is being done therein or is originating therefrom”.³²² In the event of accidents, incidents or potential emergencies the *Act* further holds that:

If an accident, incident or potential emergency arises during the performance of activities to which a licence issued under section 11 relates, the Council may, after the licensee concerned has notified the Council regarding all steps taken to prevent and limit loss of life, injury and damage to property, require the licensee to take such further steps as the Council may deem necessary.³²³

The Council may also “in the case of the suspension or revocation of a licence, give to the licensee such directions as it may deem necessary to prevent loss of

318 S 11(2)(a)-(c) of the *Space Affairs Act* 1993.

319 S 13(5) of the *Space Affairs Act* 1993.

320 S 14(1)(a)-(b) of the *Space Affairs Act* 1993.

321 S 22(1) of the *Space Affairs Act* 1993.

322 S 14(2)(a) of the *Space Affairs Act* 1993.

323 S 15 of the *Space Affairs Act* 1993.

life, injuries or damages”.³²⁴ The State is, however, protected by a limited liability clause in the *Act*, which states that:

The State or any person in the employment of the State, the Minister or the Council shall not be liable in respect of anything done under this Act in good faith and without negligence.³²⁵

Although the State is not subject to strict liability under the act, the *Act* still applies to state activities. Offences and Penalties are also dealt with extensively under the *Act* and some penalties include imprisonment for up to ten years or a fine of 1 000 000 ZAR for non-compliance.³²⁶ It is clear that the *Act* provides for the necessary authority and penalties effectively establish and enforce the needed regulations and/or guidelines with regard to space debris. These duties and liabilities will furthermore remain in force even when a license has been revoked or suspended.³²⁷ After examining the *Space Affairs Act* it has become clear that the *Act* has provided the Government with wide discretionary powers. The *Act* also provides ways to add regulations and or amendments effectively to the *Act*, provisions that will mitigate our future contribution to outer space pollution. This will soon not just be a formal requirement, but essential if South Africa is to protect its own space assets as well as to become a leader in this sector on the African continent.

The *National Space Agency Act* of 2008 establishes and authorises the South African National Space Agency (SANSa) under the Department of Science and Technology. The act does not contain any reference to outer space pollution as it is mostly concerned with the administrative and arrangement aspects of the agency and board. The agency does, however, have the following objectives:

- a) promote the peaceful use of space;
- b) support the creation of an environment conducive to industrial development in space technology;

324 S 14(5) of the *Space Affairs Act* 1993.

325 S 21 of the *Space Affairs Act* 1993.

326 S 23(1) of the *Space Affairs Act* 1993.

327 S 14(6) of the *Space Affairs Act* 1993.

- c) foster research in space science, communications, navigation and space physics;
- d) advance scientific, engineering and technological competencies and capabilities through human capital development outreach programmes and infrastructure development; and
- e) foster international co-operation in space-related activities.³²⁸

SANSA is, therefore, also committed to co-operate with other agencies and to the peaceful use of outer space.³²⁹ SANSA is tasked with implementing South Africa's space programme and is provided with wide discretionary powers in order to achieve its objectives.³³⁰ SANSA could, therefore, co-operate with the IADC and other agencies to mitigate their contribution to space debris. The *National Space Policy* published in 2008 is a guideline for public and private stakeholders in the South African space sector. This *Space Policy* sets out to promote cooperative governance, the development of the space sector in South Africa and participation in international space activities.³³¹ The *Space Policy* most importantly lists the following as one of the core principles:

South Africa is committed to being a responsible user of the space environment and will ensure that all public and private sector activities are conducted in accordance with appropriate international best practices and relevant international treaties.³³²

328 S 4 of the South African *National Space Agency Act* 2008.

329 S 5(2)(f) of the South African *National Space Agency Act* 2008.

330 S 5(2)(g) of the South African *National Space Agency Act* 2008 - do anything necessary for the proper performance of its functions or to achieve its objects.

331 Executive summary - the *National Space Policy* of 2008.

332 Policy Principles - the *National Space Policy* of 2008. Other principles hold that: South Africa is committed to utilising outer space for peaceful purposes and the benefit of all humankind; South Africa is committed to developing and maintaining a robust and appropriate set of space capabilities, services and products to support national priorities through co-ordination and co-operative governance; South Africa is committed to promoting research and development in space science and technology; South Africa is committed to fostering the development of the domestic industry towards greater levels of national self-sufficiency and international competitiveness in space technology, and its applications through utilising domestic commercial space capabilities and services to the maximum extent possible. South Africa is committed to co-operation with strategic nations in mutually beneficial and peaceful uses of outer space, with a focus on extending the benefits of space technology to the African continent through the pursuit of co-operative activities with African countries.

Government should, therefore, ensure that the outer space environment is also protected and that damage to property or the outer space environment is prevented. This will become essential as South Africa plans to enhance its space capabilities greatly which will include: manufacturing capabilities, outer space science technologies, space infrastructure and the plans to build human capital.³³³ With these plans in place, South Africa has also realised that better and more comprehensive regulations are needed for national space activities. The *Space Policy* states that:

In order to allow South African industry to compete effectively in international markets, a supportive regulatory environment shall be put in place by the Council for Space Affairs to ensure predictable and orderly participation by the private and public sectors, both within the domestic and global space arena. This shall enforce compliance with regulatory provisions and applicable international obligations, while ensuring transparent and timely processing of licence and import/export applications.³³⁴

This will also be an opportunity for South Africa to regulate the creation of outer space debris and possibly prevent the further degradation of the outer space environment with its planned activities, rather than to remediate later. Although the *Space Policy* does not explicitly mention space debris or the threat it poses to equitable access to outer space, certain core principles and values are already in place to argue the incorporation of strict mitigation guidelines easily into domestic law that will ensure that South Africa complies with its international responsibilities in respect of this problem. These regulations could also work in conjunction with certain existing environmental regulations for development on Earth, which could easily be applied to planned activities in outer space.

5 Specific environmental law principles as a guideline for outer space activities

The *corpus juris spatialis* on an international and national level clearly lacks the necessary legal control and enforcement mechanisms to address the problem of

333 7.2 Developing Adequate Space Capabilities - *National Space Policy* of 2008.

334 7.5.3 Creating the Right Regulatory Environment for National Space Activities - *National Space Policy* of 2008.

outer space debris effectively. In an effort to address the noticeable lack of enforceable legal regulation on outer space debris, the following existing principles found in international environmental law will be considered possibly to provide the foundation needed to protect the outer space environment. These principles are also a source of international law and could, as a last resort, be invoked to provide guidance in an ambiguous and unresolved situation such as the issue of space debris.³³⁵ These principles provide a basic guideline, some clarity and could act as a starting point for the further development of outer space law in order to address outer space pollution.³³⁶ The first international instrument to contain a range of comprehensive environmental principles was the *Stockholm Declaration* of 1972, which addressed problems such as transboundary environmental damage and the elements of sustainable development. In 1992, the United Nations Conference on Environment and Development took place in Rio de Janeiro where environmental principles were considerably elaborated on. This conference resulted in the *Rio Declaration*³³⁷ containing 27 principles, building on the *Stockholm Declaration* with the aim to protect the integrity of the global environment and developmental system.³³⁸ The following principles will, therefore, be discussed briefly as they are already well known and could provide some answers to the problem of outer space debris, these include: The principle of sustainable development, the precautionary principle, the principle of preventive measures, the polluter pays principle and cradle to grave principle. These principles are found in various international instruments and in national framework legislation such as the *National Environmental Management Act*.³³⁹

5.1 The principle of sustainable development

The principle or concept of sustainable development is a well-established legal principle in environmental law and was officially formulated and introduced by the

335 Viikari *Environmental Element in Space Law* 127.

336 Viikari *Environmental Element in Space Law* 128.

337 *Rio Declaration on Environment and Development*, 1992 (hereafter referred to as the *Rio Declaration*).

338 Viikari *Environmental Element in Space Law* 128.

339 *National Environmental Management Act* 107 of 1998.

Brundtland Commission in their 1987 report titled *Our Common Future*. This report defined sustainable development as:

Development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs.³⁴⁰

This meant that countries would have a duty to consider the needs of future generations and not continue to exploit natural resources regardless of the negative consequences created for future generations. Since the Commission's report, the principle of sustainable development manifested in various other international instruments and has consequently become customary international law.³⁴¹ This transpired mostly as a result of the *Rio Declaration* which ensured that the concept of sustainable development was placed solidly at the forefront of global discussion in 1992. The *Rio Declaration* stated that countries had the responsibility to ensure that development equitably meets the developmental and environmental needs of present and future generations, elaborating on the report of the Brundtland Commission.³⁴² This principle could apply to all human development that influences natural resources, even shared resources such as the outer space environment. Principles 3 to 8 of the *Rio Declaration* set out the substantive elements of this principle, referring to aspects such as the right to development, intra and inter-generational equity in resource allocation and the sustainable use of resources.³⁴³

Outer space as a natural resource should, therefore, also be used in a rational, wise, sound and appropriate manner insuring that the present and future generation will have equitable access and use of this resource. The outer space treaties and the common heritage of mankind principle, both contain elements of sustainable development, such as the right to development and access to outer space, due regard for current and future generations as well as equitable use and benefits for all mankind.³⁴⁴ Having said this, outer space should rightfully be

340 Viikari *Environmental Element in Space Law* 130.

341 Sands *International Environmental Law* 254.

342 Principle 3 of the *Rio Declaration*, 1992.

343 Bodansky, Brunée and Hey *International Environmental Law* 253.

344 Viikari *Environmental Element in Space Law* 145.

treated as a natural resource and, therefore, be protected as such.³⁴⁵ It is clear that the outer space environment and specifically orbital resources are currently not utilised in a sustainable manner and will require states to ensure that this principle is taken into consideration if future exploitation is to remain viable. Mankind cannot idly sit back and rely on the possibility of better technologies and money to remove space debris even as the space environment is deteriorating rapidly, creating serious obstacles for all current and planned outer space activities.³⁴⁶ The principle of sustainable development is also found on a national legislative level under section 2 of *NEMA* and is defined in the act as:

The integration of social, economic and environmental factors into planning, implementation and decision-making so as to ensure that development serves present and future generations.³⁴⁷

South Africa is clearly bound to ensure that all developments take future generations into consideration. Section 2 of *NEMA* contains the principle of sustainable development and other environmental principles, stating that these principles bind the actions of all organs of state throughout the country. *NEMA* further states that:

The social, economic and environmental impacts of activities, including disadvantages and benefits, must be considered, assessed and evaluated, and decisions must be appropriate in the light of such consideration and assessment.³⁴⁸

Even though these principles were meant only to apply and be enforced within the national jurisdiction of South Africa, they could serve as a guideline to ensure that South Africa's outer space activities are conducted in a sound and sustainable manner, ensuring that international obligations are met. *NEMA* moreover, holds that "development must be socially, environmentally and economically sustainable".³⁴⁹ Considering the immense impact that outer space technology has and will have on the economic and social development in South Africa, outer

345 Bodansky, Brunée and Hey *International Environmental Law* 253.

346 Viikari *Environmental Element in Space Law* 147.

347 S 1 of *NEMA*.

348 S 2(4)(i) of *NEMA*.

349 S 2(3) of *NEMA*.

space debris cannot be ignored in light of the growing threat to the equitable access to outer space, making this not just an environmental consideration but an economical concern too.

5.2 The precautionary principle and the principle of preventative measures

The precautionary principle is another well-established principle in environmental law which could offer valuable legal guidance when considering further developments in outer space. The precautionary principle can also be found under principle 15 of the *Rio Declaration*, which holds that:

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.³⁵⁰

This principle had its beginnings in Germany in the principle of *Vorsorge*, which meant that society should carefully plan future developments and seek to avoid any potentially harmful activities.³⁵¹ This principle has since been used in various areas of environmental concern such as the pollution of the North Sea, the depletion of the ozone layer, climate change, coastal management and the use and disposal of hazardous materials.³⁵² The precautionary principle is central to sustainable development and in essence aims to prevent environmental harm as opposed to solving problems at a later stage that we might not have been aware of now. If scientific evidence regarding the negative consequences of actions is unclear, this principle will find applicability and should therefore be followed.

This principle should, therefore, easily apply to outer space activities where there are many scientific uncertainties.³⁵³ However, this does not mean that all space activities should be banned as they are all potentially hazardous and all carry

350 Principle 15 of the *Rio Declaration*, 1992.

351 The precautionary principle in action 2.

352 The precautionary principle in action 2.

353 Viikari *Environmental Element in Space Law* 173.

inherent dangers to humans and the environment. The precautionary principle would mean that countries should consider their activities in outer space carefully, not unnecessarily creating more debris by using anti-satellite technologies or undertaking purely commemorative missions such as the launch of reflecting spheres into outer space to celebrate the Eiffel Tower.³⁵⁴ According to scholars, there should be a balance of benefits in view of the current situation in outer space.³⁵⁵ Although there is no fixed meaning describing the precautionary principle as it has been adapted to numerous human activities and adopted by various different countries, all in agreement that states should act carefully when their activities have the potential to harm or impact the environment significantly.³⁵⁶ All human activities will have some kind of impact on the environment and states should continuously strive to reduce their impact whether conclusive evidence exists that harm will occur or not.³⁵⁷ The precautionary principle was, furthermore, incorporated into *NEMA* under sustainable development and holds that a “risk-averse and cautious approach should be applied, which takes into account the limits of current knowledge about the consequences of decisions and actions”.³⁵⁸ Although the consequences of outer space debris is to a certain extent known to science, this principle still serves as an important margin for those activities which poses a threat to the outer space environment of which the consequences are still unclear.

The principle of preventative measures can, therefore, provide the necessary basis for action to be taken with regard to outer space pollution. The principle of preventative measures or action can be seen as an embodiment of all national legislation with the aim to protect the environment and to prevent local and transboundary environmental damage.³⁵⁹ This principle will, therefore, provide a valuable foundation if applied to the issue of outer space debris, as it substantiates the need for domestic and international regulation preventing

354 Viikari *Environmental Element in Space Law* 175.

355 Viikari *Environmental Element in Space Law* 175.

356 Sands *International Environmental Law* 254.

357 Sands *International Environmental Law* 254.

358 S 2(4)(a)(vii) of *NEMA*.

359 Sands *International Environmental Law* 254.

transboundary damage, regardless of where it occurs. Principle 11 of the *Rio Declaration* holds that:

States shall enact effective environmental legislation. Environmental standards, management objectives and priorities should reflect the environmental and developmental context to which they apply. Standards applied by some countries may be inappropriate and of unwarranted economic and social cost to other countries, in particular developing countries.³⁶⁰

From this statement it can be reasoned that similar domestic legislation should be enacted in the context of outer space debris, preventing economic and social costs to other countries, especially developing countries in outer space. The preventative principle has been utilised in numerous treaties to address environmental harm, especially harm caused by pollution on earth, it could, therefore, extend to activities in outer space. The principle of *sic utere tuo, ut alienum non laedas* meaning to use your property in such a way as not to injure that of another, is one more important principle which could easily extend its reach to the outer space environment.³⁶¹ This was evident in the *Trail Smelter* and *Corfu Channel* cases discussed previously. In addition the principle of due diligence (to take reasonable care) known in outer space law, will strengthen protection as states will incur responsibility for the acts of their citizens as well as non-state entities if the issues discussed previously could be addressed.³⁶² These principles, well rooted in international law, could all apply and strengthen the case to not only protect the outer space environment but ensure sustainable development in outer space.

5.3 *The polluter pays principle*

The polluter pays principle is another principle found in national and international environmental law directly applicable to the issue of outer space pollution. This principle is another principle open to interpretation and could easily be extended to apply to outer space pollution. The polluter pays principle originated in the early

360 Principle 11 of the *Rio Declaration*, 1992.

361 Viikari *Environmental Element in Space Law* 150.

362 Viikari *Environmental Element in Space Law* 155.

1970's as a solution to distortions in international trade and environmental damage caused by support given to polluting industries.³⁶³ This principle evolved over the last few decades and now holds that the "costs of pollution should be borne by those who are responsible for the pollution, including the cost of the necessary prevention and control measures".³⁶⁴ It is clear that economics are at the core of this principle, generating negative feedback by some scholars who believe that this principle sets a price on the environment.³⁶⁵ This principle when applied correctly in cooperation with principles such as the precautionary and preventative principles can insure that the environment is protected and that damage that were not prevented can be remediated. The polluter pays principle can, therefore, be the necessary step in addressing outer space pollution when clean-up technologies do become readily available and could ensure that the outer space environment be restored to a certain extent. The polluter pays principle is also found in the *Rio Declaration* under principle 16 and holds that:

National authorities should endeavour to promote the internationalisation of environmental costs and the use of 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.³⁶⁶

With the considerably diluted strength of this principle due to the use of words such as "endeavour" and "promote", it could still provide valuable guidance to finding appropriate solutions to outer space pollution. If issues discussed under the *Liability Convention* are addressed, this principle could effectively elaborate on the protection of not only assets in outer space but also the protection of the outer space environment itself from deliberate and unnecessary pollution. As stated in the *Rio Declaration* national authorities should promote this principle and South Africa has, therefore, also included this principle in *NEMA*, which holds that.

The costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further

363 Sands *International Environmental Law* 281.

364 Viikari *Environmental Element in Space Law* 185.

365 Viikari *Environmental Element in Space Law* 185.

366 Principle 15 of the *Rio Declaration*, 1992.

pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment.³⁶⁷

The polluter pays principle can also be viewed as an effective economic instrument to insure that the polluters pay for the prevention, control and remedying of pollution. One can, however, not be ignorant to the many obstacles this principle faces, relying on a very flawed *Liability Convention* and taking into consideration the many other technical difficulties in outer space, the polluter pays principle could still find applicability in the issue of outer space pollution.

5.4 The cradle to grave principle as part of the project life cycle

The cradle to grave principle is associated with the project life cycle assessment. The life cycle assessment is a method used to assess and predict the negative effects or consequences of human activities throughout a project's life cycle.³⁶⁸ The cradle to grave principle accompanies this assessment and requires developers to minimise or prevent these negative consequences from occurring.³⁶⁹ The project life cycle comprises of several phases and sub-phases which generally include: "the planning and design phase, the procurement and contractual phases, the implementation phase with sub-phases such as construction; commissioning; operations; redesign; optimisation; expansion and modification; maintenance; decommissioning; dismantling."³⁷⁰ The cradle to grave principle is applicable throughout all phases of the project life cycle and could easily manifest in other projects such as outer space projects. On a national level *NEMA* refers to various principles applicable to waste and the project life cycle, these include:

- (iv) that waste is avoided, or where it cannot be altogether avoided, minimised and reused or recycled where possible and otherwise disposed of in a responsible manner;

367 S 4(p) of *NEMA*.

368 Baker *Emerging Principles of International Environmental Law* 155.

369 Baker *Emerging Principles of International Environmental Law* 155.

370 *Environmental management handbook* 15.

- (v) that the use and exploitation of non-renewable natural resources is responsible and equitable, and takes into account the consequences of the depletion of the resource;
- (vi) that the development, use and exploitation of renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity is jeopardised.³⁷¹

Developers of spacecraft should, therefore, also prevent pollution, not only on Earth, but also in outer space. States should initially attempt to reuse spacecraft (“cradle to cradle principle”), but if disposal is unavoidable sound waste management principle should be enforced to ensure responsible disposal such as the use of junkyard orbits. On Earth the project life cycle works hand in hand with certain environmental planning, acting and checking tools. These include: environmental impact assessments (EIA), environmental risk assessments (ERA) and environmental management plans (EMP) to ensure that the environment is utilised and managed in a sustainable manner.³⁷² This is unfortunately not a “one size fits all” system and every project will have its own distinct phases, requiring managers to select the right tools for the right job at the right time.³⁷³ Certain tools could, therefore, similar to activities on Earth, apply to outer space activities, insuring compliance and enforcement of future requirements as set in the relevant national legislation and regulations.

6 Conclusion and recommendations

Considering the immense difficulties faced by space developers as a result of outer space debris, it is clear that drastic legal and political action will be necessary on an international and national level. With the growing dependence on outer space technologies in developed and developing economies around the world, the global community cannot ignore the immense negative consequences space debris could pose to their development. The space debris problem, unlike other environmental problems on Earth can possibly be solved by future clean-up technologies, currently unfeasible due to the massive costs and level of

371 Ss 2(4)(a)(iv)-(vi) of *NEMA*.

372 *Environmental management handbook* 15.

373 *Environmental management handbook* 17.

technology involved. Space exploration and tourism is expected to grow exponentially over the next few decades and will require, if only for the time being, states to avoid further pollution of the outer space environment as prevention will always remain better than cure.

Countries such as South Africa could soon find that the planned developments will face various difficulties as a result of outer space pollution. South Africa is expected to invest a substantial amount of resources in the development of outer space infrastructure and as a responsible user of the outer space environment, should be aware of the possible impact this might have. It is also apparent that countries already have the responsibility to utilise the outer space environment in a sustainable manner but due to poor coordination and the lack of sound international and national law, the problem of space debris has continued to spiral out of control.

Voluntary measures to address outer space pollution have been inconsistent and unenforceable, contributing to the problem as the outer space treaties have always been inadequate to address the problem of outer space debris. As a result numerous likeminded academics such as Sénéchal are recommending certain substantial amendments to the outer space treaties as well as advocating the creation of a global space debris convention.³⁷⁴ Sénéchal suggests a convention constructed around four basic objectives, indicating the main shortcomings of the outer space treaties. Objective one is to quantify the problem of space debris by independently tracking and cataloguing space debris.³⁷⁵ Objective two will require the adoption of enforceable “Space Debris Mitigation and Disposal Standards”.³⁷⁶ Objective three will see the inclusion of certain space preservation areas protected due to their scientific and economic importance.³⁷⁷ Objective four involves a liability, compensation and dispute resolution system that will address the overall shortcomings found in the current outer space treaties.³⁷⁸ With a space

374 Sénéchal 2007 www.spacegeneration.org 40.

375 Sénéchal 2007 www.spacegeneration.org 76.

376 Sénéchal 2007 www.spacegeneration.org 76.

377 Sénéchal 2007 www.spacegeneration.org 76.

378 Sénéchal 2007 www.spacegeneration.org 77.

debris convention as one approach to possibly solving the problem of space debris, the fact remains that any attempt to solve this problem will require extensive cooperation and adherence by all, as even one rogue nation or private entity could nullify the efforts and progress made.

The OST, specifically article I requires that the exploration of outer space should be carried out to the benefit of all countries irrespective of their degree of development. It is, therefore, only reasonable that all countries should equally take steps to protect the outer space environment within their individual capabilities. Outer space as the common heritage of mankind should be protected for the benefit of current and future generations in accordance with the level of protection already afforded to the other global commons. Once again this can only be accomplished with the development of appropriate international and national law. By looking past the issues of sovereignty and working together to build on some of the foundations already found in international space treaties, including characteristics found in environmental law principles, the common heritage of mankind principle and existing mitigation guidelines, success is possible. The remodelling or creation of new outer space treaties should not be seen as an impossible task as the growing community of space faring nations would undoubtedly want to avoid similar disputes now facing climate change negotiations. For that reason, clear obligations and consequences are needed as soon as possible.

The implementation of appropriate national legislation will further ensure that state and non-state activates comply with the future dictates of international law. Projects should be thoroughly managed and monitored on a national level according to international standards ensuring the minimisation of outer space debris. Moreover many legal issues mentioned in this dissertation should also be avoided on a national level, specifically the issue of liability and registration, ensuring accountability. South African national legislation will face similar challenges as it does not contain any reference to the problem of outer space debris. If South Africa plans to become the leader of outer space services on the African continent, national legislation must anticipate and regulate various challenges facing all space faring nations. Thus, after examining the international

and national legal framework regarding outer space pollution, it is clear that extensive amendments to the legal framework are necessary. If future endeavours, no matter how small or big, are to remain viable for current and future generations, the problem of outer space pollution should be addressed with the necessary urgency.

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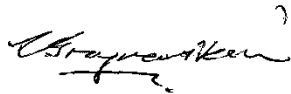
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LESLEY ANN GREYVENSTEIN (PROF)

P O Box 6601
Flamwood
Klerksdorp
2572

Tel: 018 468 7335/082 974 4505