UNIVERSITY OF NAIROBI

INSTITUTE OF DIPLOMACY AND INTERNATIONAL STUDIES

AFRICA'S INTERNATIONAL RELATIONS IN OUTER SPACE ACTIVITIES

MWANGI ELIZABETH WANGARI

REG: R50/74160/2014

A Research Project Submitted in Partial Fulfilment for the Award of Masters of Arts Degree in International Studies, University of Nairobi

OCTOBER 2016

DECLARATION

I, Mwangi Elizabeth Wangari hereby declare that this research project is my original work and has not been presented for a degree in any other University.

Signed…… Date……

Mwangi Elizabeth Wangari

This project has been submitted for examination with my approval as University Supervisor;

Signed…… Date……

Dr. S. Handa

Supervisor

Institute of Diplomacy and International Relations

ACKNOWLEDGEMENTS

My deepest gratitude goes to my supervisor, Dr. S. Handa who supported me throughout this project through patiently providing constructive critic and positive suggestions during this study. It was a great honour to undertake this project under his supervision. I also thank the entire IDIS fraternity for the administrative support and my classmates from International Studies Masters who supported me and were more of a family to me.

DEDICATION

I first dedicate this work to God for enabling me to get this far. I also dedicate this thesis to my parents and especially my mother, Lois Mwangi, who has stood by me wholly through my life and education. My father, Peter Samson Mwangi taught me the importance of having a third eye to be able to view issues beyond the ordinary. This project is result of the same. My loving husband Joash, my siblings George, Daniel, Catherine, Stephen, Joseph and my lovely children Tatyana, Leeroy and Achim motivated me to succeed.

ABSTRACT

The purpose of this study was to explore Africa's relations in enhancing its global standing in the Outer space frontier. The population of the study included all the Fifty four states in the African continent. The study employed stratified sample of the study population with Morocco, South Africa, Kenya and Nigeria representing the Northern, Southern, Eastern and Western regions/stratums respectively. The study achieved its goal through three objectives namely to examine intra African cooperation in outer space; to interrogate the extent and scope of Africa's relations with other state and non-state space actors and to identify the key challenges that Africa faces in her International Relations in outer space activities. The study employed the realist theory of international relations and reviewed relevant literature aimed at meeting the set objectives. The research used a mixed method approach of data collection by examining both primary and secondary data. In this regard, questionnaires were administered to key informants and data was also obtained from journals, internet articles like the UNOOSA website and austranautix.com, reports and circulars on outer space related activities in Africa. The study concludes that there is minimal engagement of African countries in space related activities compared to other regions globally. The space sector in Africa is also marred by a lot of challenges key among them being affordability, poor policies and lack of coordination. The research recommends that African states develop an indigenous space industry that promotes and responds to the needs of the African continent, collaborate more to avoid duplication and implement the already existing space policies that emphasize on fair and mutually beneficial partnerships, capacity building and funding. The study further recommends that more research is done in this area to bridge the knowledge gap and lack of information on the space activities in the African continent.

ABBREVIATIONS AND ACRONYM

AEGOS	African-European geo-resources observation system
AERONET	Aerosol Robotic Network
AGHRYMET	Agro meteorology and Operational Hydrology
ALC	African Leadership Conference on Space Science and Technology for Sustainable Development
AMCEN	African Ministerial Conference on the Environment
AMCOST	African Ministerial Committee for Science and Technology
AMESD	African Monitoring of the Environment for Sustainable Development
ARCSST-E	African Regional Center for Space Science and Technology Education in English
AREM	African Resource and Environmental Management
ARMC	African Resource Management Satellite Constellation
ARMS	African Resources Management Satellite
ASA	Africa Space Agency
AU	African Union
CEMAC	Central African Economic and Monetary Community
CILLS	Inter-State Committee for Drought Control in the Sahel
CNSA	China National Space Administration
COPUOS	Committee on the Peaceful Uses of Outer Space
CPA	Consolidated Plan of Action for Science and Technology
CPUT	Cape Peninsula University of Technology

CRERS	Royal Center for Space Studies and Research
CRTS	Royal Centre for Remote Sensing
DMC	Disaster Management Constellation
ECA	Economic Commissions for Africa
ECOWAS	Economic Community of West African State
EGNOS	Europe's first satellite navigation system
EO	Earth Observation
ESA	European Union's Space Agency
FAO	Food and Agriculture Organization
FEWS-NET	Famine Early Warning System Network
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GIS	Geographical information system
GMES	Global monitoring for environment and security
GPS	Global Positioning System
IAA	The International Academy of Astronautics'
IAU	International Astronomical Union
ICPAC	IGAD Climate Prediction and Application Centre
ICT	Information and Communication Technology
IGAD	Intergovernmental Authority on Development
INCOSPAR	Indian National Committee for Space Research
INSPIRE	Infrastructures for Spatial Information in European Community
IPCC	Intergovernmental Panel on Climate Change

ISRO	Indian Space Research Organization
ISS	International Space Station
ITU	International Telecommunication Union
JSPOC	Joint Space Operations Center
MARSE	Moroccan Association of Remote Sensing of the Environment
MESA	Monitoring for Environment and Security in Africa
MOM	Mars Orbiter Mission
NASA	National Aeronautics and Space Administration
NASRDA	National Space Research and Development Agency
NEPAD	New Partnership for Africa Development
OAD	Office of Astronomy for Development
OAU	Organization of the African Unity
PSLV	Polar Satellite Launch Vehicle
PUMA	Preparation for Use of Meteosat Second Generation in Africa
RAMSES	Regional Earth Observation for Mediterranean Sea Emergency Surveillance
RECs	Regional Economic Communities
RCMRD	Regional Centre for Mapping of Resources for Development
ROSCOSMOS	Russian Federal Space Agency
SADC	Southern African Development Community
SANSA	South African National Space Agency
SKA	Square Kilometer Array project
SSP	Satellite Sentinel Project

STEM	Science, Technology, Engineering and Mathematics
UNSPIDER	United Nations Platform for Space-based Information for Disaster Management and Emergency Response
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNCCD	United Nations Convention to Combat Desertification
UNEP	United Nations Environmental Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNISPACE	United Nations Conference on the Outer Space
UNITAR	United Nations Institute for Training and Research
UNOOSA	United Nations Office for Outer Space Affairs
USAID	U.S. Agency for International Development
USGS	U.S. Geological Survey
WFP	World Food Programme
WHO	World Health Organization
WMO	World Meteorological Organization

LIST OF TABLES

LIST OF FIGURES

TABLE OF CONTENTS

CHAPTER ONE

INTRODUCTION

1.0 Introduction

This introductory chapter divided into thirteen sections provides a background contextualizing the research study. The chapter first entails a brief background of the global outer space field journey including that of Africa and other regions and the need for Africa to seek a global positioning in this field. The chapter further describes the research problem and lists the objectives and the justifications of carrying out the study.

The realist theory applied throughout the research project is introduced in this chapter in addition to the literature review. Further, the chapter includes a recap of the research methodology detailing the research design used in the data collection through to the data analysis. In conclusion, the chapter gives a summary of the expected chapter outlines and outcomes of the study and finally the tools of data collection among other attachments are presented in the appendices.

1.1 Background

Oral tales indicate that outer space activities on earth are as old as man himself; however documented space activities began with the launching of the first artificial satellite, Sputnik, by the Soviet Union in 1957.[1] Two years later the Committee on the Peaceful Uses of Outer Space (COPUOS) was set up by the United Nations General Assembly in 1959 to govern the activities and use of space for the benefit of all humanity: for peace, security and development.[2] Ever since, outer space activities have

[1] Dickson P. *Sputnik: The Shock of the Century Science Matters* (Berkley Books, 2001)
[2] John A Moore, Jerry Pubantz, *The New United Nations: International Organization in the Twenty-First Century* (Routledge, 2015) p.89

reflected major International relations issues like competition and cooperation of States, polarity, and globalization among others. There has also been an increase in the number of State and non-State actors engaged in outer space activities after the cold war period[3] as countries began pursuing their own national interests as opposed to undertaking activities based on the consideration of the realignment to either the United States or the Soviet Union that existed then. In addition, technology that has been realised from outer space research is being used to wrestle a number of international challenges, such as global warming, terrorism, proliferation of weapons of mass destruction and development issues.

COPUOS was tasked with reviewing international cooperation in peaceful uses of outer space, establishing outer space activities that could be undertaken by the United Nations, encouraging space research programmes, and finding out the legal problems arising from activities of outer space.[4] In this regard, the Committee that forms the forum for the development of international space law has so far concluded five international treaties and five sets of principles on space-related activities.[5]

Over the decades, the increase in the number of space launchings registered with the United Nations shows that human beings have been greatly influenced by space science and technology. The United Nations estimates that outer space activities initiatives generate $257 billion each year.[6] By mid-2015, 13 States had independent space launch capability, over 60 countries operated their own satellites, and worldwide over 70 space agencies were in operation. Moreover, more than 1200 satellites were

[3] Neil Morris, *What Does Space Exploration Do for Us? Earth, Space, and Beyond, (*Raintree, 2012) p.28
[4]http://www.unoosa.org/oosa/en/ourwork/copuos/index.html
[5]http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties.html
[6]Space Foundation, 'Space Applications for International Development', *The Space Report*, (Colorado Springs: 2009). http://www.thespacereport.org/.

being operated, and thousands of new satellites were seriously under development to be launched in the near future.[7] Despite an expansion in the number of nations with space programmes or those that have launched operational satellites in the outer space; there are a few distinct leaders in terms of space capabilities and spending.[8] Outer space development therefore is still purview of wealthy visionaries, a situation that will intensify the world's inequality and instability.[9]

Competition for power among actors in the International arena has moved from land, sea and air frontiers to the outer space and it is evident in our world today that outer space activities are shaping international relations as States and their peoples become more dependent on satellite signals. In times of conflict, it would be easy for States to target satellites of an enemy State hence the potential of the outer space to be the new battlefield[10] and space power to be the modern-day equivalent of the 18th-century sea-power domain described by Alfred Thayer Mahan.[11] Countries with global ambitions now understand that lack of significant space capabilities will neither attain nor retain their global pre-eminence.[12]

Even with the labeling of being poor, empty or whatever other adjectives Africa has been given, Africa in its effort to liberate itself transformed the OAU to AU in 2000. African States then developed the Consolidated Plan of Action for Science and

---

[7] The Space Treaties at Crossroads: Considerations for de legeferenda, *International Conference on New Challenges in Space Law*, (28 - 29 August, 2015, Athens)
[8] Lewis James Andrew, 'Space Exploration in a changing International environment', *A report of the Center for Strategic & International Studies* (CSIS), (July 2014) pp.5
[9]Weeks Edythe, *Outer Space Development: International Relations and Space Law: A Method for Elucidating Seeds* (Newcastle upon Tyne, U.K.: Cambridge Scholars Publishing, 2012).
[10]Bolt Paul J., Coletta Damon V. Coletta & Shackelford Collins G., *American Defense Policy: American Defense Policy Series*. (JHU Press, 2005) pp.382-384
[11] Mahan, A. T., *The Influence of Sea Power upon History*, (Digital Antiquaria, Incorporated, 2004)
[12]Sabathier Vincent G. & Faith G. Ryan, 'The Global Impact of the Chinese Space Program', *World Politics Review,* (May 17, 2011), http://www.worldpoliticsreview.com/articles/8878/the-global-impact-of-the-chinese-space- programmes

Technology (CPA) consisting of Space Science as one of its flagship projects. This provided a platform for cooperation of African States in the area of outer space activities. Furthermore, a few African countries independently then also started investing in the development of space infrastructure and bold space science programmes. However, the majority of AU member states are yet to make significant investments in the outer space activities programmes. Most of these African countries lack the human, technical and financial resources to utilise existing space-based infrastructure for even the most basic applications. The AU for a long time also lacked the necessary policies and strategy to guide Space activities in Africa. It is only until recently during their Twenty-Sixth Ordinary Session held in Addis Ababa in early 2016, that the African Union Heads of State and Government adopted the African Space Policy and Strategy. This was the first of the concrete steps to realize an African Outer space programme, as one of the flagship programmes of the AU Agenda 2063.

But as the race for outer space occupation gains momentum both in the developed and developing world, there is realisation that the pace of technological advances is too costly for single states and therefore a need fronted by the United Nations to establish space cooperation. Through this International, regional and bilateral cooperation, the use and development of space science and technology is enhanced and the gap between member countries bridged.

Despite the promotion of cooperation of States in Outer space activities, there are pertinent issues on the same especially in regards to developing countries such as those of Africa. Some of those issues include information sharing, monopolization of space activities by developed countries in order to maintain technological supremacy,

militarization of outer space, spying, access by all member states to the benefits of space technology, congestion of space hence threat of satellite collision, disputes over allocation of orbital assignments and dangerous debris moving at high speeds over the earth[13] among many other issues. This study outlines those issues with a focus on Africa's relation with itself and other State and non-state space actors.

Firstly, there is a lot of space debris caused by the numerous space satellites and objects that have been launched into Space by the many States and non-State space actors. Such debris, resulting from decades of space activity, pose considerable hazard to spacecraft and people across the globe including in Africa. The space is also being weaponized by the world powers and a break out of a war in Space could have disastrous effects on Africa. Technological advancements and profits made by the space powers through launches from Africa due to the equator, large terrains and clear skies do not trickle down to Africa. Geographical position like proximity to the equator and huge uninhabited terrains are crucial for the launch of a satellite. The closer the launch site is to the equator, the more efficient the launch[14] and a large number of uninhabited territory around the launch site ensures that the population is not affected by accidents or the debris.

Space launches from Africa have been done long before some African counties got independence. Even though the Space objects launched do not belong to Africa, Africa should have a share in the millions of dollars accrued from such programmes to be able to bridge the economic gap that exists with its partner States launching these objects.

[13]Al-Rodhan Nayef R.F, *Meta-Geopolitics of Outer Space: An Analysis of Space Power, Security and Governance*, (St Antony's.Palgrave: Macmillan, 2012) pp.3
[14]Pelton Joseph N., Oslund Robert J. & Marshall Peter, *Communications Satellites: Global Change Agents*, (LEA Telecommunications Series, Routledge, 2004) pp.102

African States have ratified all the International treaties and principles on peaceful use of the outer space for all. The Western and Eastern Space powers are now engaged in a Space arms race and spying.[15] Initiatives by African countries to engage in Space activities is discouraged by global powers in the pretext of the excuse that Africa is poor and with many other problems therefore should deal with those problems first before engaging in Space while it is common knowledge that the Space powers themselves started engaging in Space activities when there countries had numerous problems of diseases, internal conflicts, hunger, among others. It is difficult to dismiss an assumption like African States have been coerced into signing or that majority are ignorant on the bilateral and multilateral agreements on Outer space activities given the aforementioned issues.

Africa's call for peaceful use of the Outer Space when they are not active even in the Space themselves is not viable. Furthermore, Satellites are used to demonstrate national awareness of a particular threat.[16] Africa is not therefore able to effectively protect its citizenry when it cannot access what other States have in relation to access to its people, resources, territory and any other information about it thanks to the technologies from Space. There is therefore a need to identify if cooperation and agreements entered into are of mutual benefit to both Africa and the partners.

Is Africa able to participate in the push for peaceful use of outer space without necessarily being active in Space? Africa is made up of sovereign States that have been debating for a long time about equality of States and arguing that they are racing to be at per with other states economically, socially and scientifically.

---

[15] Lambakis Steven, *On the Edge of Earth: The Future of American Space Power*, (Kentucky: University Press of Kentucky, 2001) pp. 39-71

[16] Ibid, Lambakis, pp.60

This research establishes answers to some of the pertinent questions raised. In this regard, the study has been narrowed down to focus on the nature and challenges of Africa's relations with itself and other State and non-State Space actors. This study therefore investigates these relations, their possible evolution and the consequences for Africa. It evaluates the potential impact on Africa's space activities and on its cooperation with its partners.

1.2 Problem Statement

Africa needs to be in Space because outer Space systems are now global utilities that provide critical modern infrastructure for all the nations and people on Earth. Africa is host to various launching and landing sites for space objects by other States and non-State space actors from the West and the East. There are also numerous agreements in regards to outer space activities that African States have entered into independently or as part of regional blocs. Exploration and utilization of outer space is an expensive venture especially for a continent like Africa to go it alone. There is therefore need for cooperation in various areas such as financially, technologically, scientifically, also through training and policy formulations in outer space initiatives for the continent so as to accrue the benefits from Space like other regions. This study interrogated the efforts and challenges from African States to unite and strengthen a regional Space establishment to benefit all the African States and further seeks to establish whether the relations that Africa has with itself and other space actors are beneficial to the continent and if not why.

1.3 Research Questions

The research sought to answer the following questions:

1. How do African states cooperate on issues of Outer space?
2. What is the extent and scope of Africa's relations with other state and non-state space actors?
3. What are the key challenges that Africa faces in her International Relations in outer space activities?

1.4 Objectives

1.4.1 Main Objective

To explore Africa's relations in enhancing its global standing in the Outer space frontier

1.4.2 Specific Objectives

1. To examine intra African cooperation in outer space
2. To interrogate the extent and scope of Africa's relations with other state and non-state space actors
3. To identify the key challenges that Africa faces in her International Relations in outer space activities

1.5 Literature Review

This research reviewed thematic literature related to the study. The literature from books, journals, reports and online articles examined the dynamics of International relations of post independent Africa through to during and after the cold war. This was connected to development of the Outer Space activities in the continent. The study also focused on literature on the cooperation efforts of African states in developing a regional space agency amidst their independent desires to also enhance their national space programmes. The literature reviewed further informs on some of the agreements that African countries have entered into with other space actors and the challenges therein.

This review was done for the comprehension of the underlying issues that inform Africa's relations when it comes to Outer space affairs in the global arena.

1.5.1 Intra African Cooperation on Outer Space

Outer space development in Africa seems to be caught between the desire to come up with one united front of an African Space Agency and the reality of independent States interest to establish national agencies first. Peter Martinez as cited by Augustine[17] cautions the idea of establishing an Africa Space Agency (ASA) as premature, arguing that other African countries that have not yet participated in space endeavours need first to develop their own capabilities so that they can participate fully in the development of the ASA. However, Gottschalk[18] differs, stating that the development of the ASA could provide the vehicle for the continent to negotiate better offers for satellite construction, space launches, technology transfer and infrastructure, than could individual countries alone. Attesting to this, Abiodun[19] states that space activities is a total global engagement and therefore continents ought to have one voice towards space utilization.

Cooperation agreements on space activities have allowed emerging spacefaring nations from Africa to reap social and economic benefits from space applications. In 2009, after years of discussion, Nigeria, Algeria, South Africa, and Kenya signed a regional cooperation agreement for an African Resources Management Satellite (ARMS) Constellation.[20] Many of Africa's developmental challenges transcend national, cultural

[17] Augustine A.A., *Africa considers a continent-wide space agency, Science and Development Network*, http://www.scidev.net/en/news/africa-considers-acontinent- wide-space-agency.html, 20th August 2010 and 18th June 2012

[18] Gottschalk K, 'South Africa's space programme – Past, present, future', *Astropolitics*, Vol VIII, No. 1, (2010) pp. 35-48, http://dx.doi.org/10.1080/14777622.2010.496528

[19] Abiodun A.A., 'Future trends in the global arena: Challenges and opportunities for Africa' *African Skies/CieuxAfricains*, Vol XII (2008) pp.12–22.

[20] Ngcofe Luncedo & Gottschalk Keith. 'The growth of space science in African countries for Earth observation in the 21st century', *South African Journal of Science*, Vol CIX, No.1/2 (2013) pp.1-5

and linguistic differences; therefore, collective impact of national space programmes can be greatly enhanced through cooperation. Regional and interregional cooperation and coordination provide essential mechanisms for advancing such efforts.[21]

1.5.2 Africa's Relations with Other State and Non-State Space Actors

Hans Morgenthau, a classical realist in his textbook Politics among Nations, states that Africa did not have a history before the First World War hence was a politically empty space.[22] However a South African author Nasila Rembe[23] contradicts this and argues that before the colonial period, Africa had evolved kingdoms and civilisations of sizable expanse and longevity that enjoyed and conducted trade, diplomatic and other forms of interaction within and between it and the outside world. He further argues that post-independence Africa had lost their initial powers structures to enter into International relations as it comprised of States formed by the European colonial powers. This is because external relations had changed to be conducted under International law identified with the European powers.[24]

This incoordination has led to dominant perspectives in International Relations sometimes dismissing Africa as a weak and marginal continent, a battleground for great power rivalries littered with failed states and vestiges of pre-modern societies.[25] Other authors view Africa as a key actor in International Relations and like no other continent has a complex pattern of national boundaries, ethnic, religious and tribal sub-systems

---

[21] United Nations, *Space Benefits for Africa: U.N. Doc. IAM/2009/CRP.7* (United Nations Inter-Agency Meeting on Outer Space Activities, Twenty-ninth session, 4-6 March 2009, Vienna)
[22] Hans Morgenthau, *Politics among Nations: The Struggle for Power and Peace*, (New York: Alfred A. Knopf, 1960) pp.3-15
[23] Rembe, Nasila S., 'Africa and the International Law of the Sea: A Study of the Contribution of the African States to the Third United Nations Conference on the Law of the Sea', *Series on Ocean Development,* Vol. VI, No. 5, (BRILL, 1980)
[24] Ibid
[25] carl.death@manchester.ac.uk

interacting with sectoral systems[26]. These diverse and now sovereign States of Africa have distinctive foreign policies that sometimes present challenges to a single continental policy.

Harman and Brown[27] site Africa's significance within International relations in various ways. First, it is the geographical space where much that is systemically important in international relations has played out, from colonial rule to resource competition to post-conditional aid dependency. It is also the site of much empirical research into the practice of international relations, with regard to old and new security threats such as weak state contagion or piracy, and also with regard to the impact of orthodox neo-liberal economics on policy-making and state reform. Thirdly, Africa is both the site of social change and uprising, as recently in North Africa, and the space in which new power configurations emerge, as in the case of Nigeria and South Africa, and old power configurations play out. The research on Africa in these areas is rich in empirical detail and would suggest that the continent represents a flourishing field for IR.

During the Cold War, many African nations were aligned to either the Soviet Union or the United States despite the notion of some forming the non-aligned movement. The two powers were also the Space powers. The scenario today is different. In addition to relations with the West and the now defunct Soviet Union, Africa has also included economic and trade relations with powerful emerging economies: China, India, Brazil, Russia (BRICS) and others such as the Middle East and Malaysia. Likewise, there now exists various bilateral and multilateral agreements in relation to cooperation in the

[26]Muchie Mammo, Gammeltoft Peter & Lundvall B. A., '*Putting Africa First', The making of African innovation systems*, (2003).
[27]Harman, S. & Brown, W., *In from the margins? The changing place of Africa in International Relations*, (International Affairs, 2013) pp.69–87

outer space within and without Africa. Many nations have a presence in Space and many other nations plan to join them.[28]

1.5.3 Africa's Challenges in Its International Relations in Outer Space Activities

Authors Christian Brunner and Alexander Soucek,[29] indicate that Africa lacks capacity and interest in outer space applications. They argue that National Space agencies and space activities do exist throughout Africa, but the level of commitment and development is less high than most other regions of the world.

Most African States are predominantly suffering from the absence of an innovative scientific culture, institutional failure, or state collapse, which generally results in poor policy formulation, implementation, output and poor service delivery to its population. This vicious political cycle often reinforces itself and results in socio-economic and political instability. In the absence of optimally functioning state institutions, African states are in no position to ratify any international treaty, nor implementing obligations resulting from this ratifying a particular treaty. In cases where African states have ratified these and other treaties, it often lacks the institutional and scientific capacity, and political will to comply with its treaty obligations.

In addition to Africa challenges in cooperation and competition in the area of outer space activities, the continent has to also deal with the emerging trends and implications of the global development of Outer space as well articulated by Author Edythe E. Weeks. She describes the concept of an international regime where she argues that the outer space is in the process of being developed, and that the likely implications

[28] Lewis James Andrew, 'Space Exploration in a changing International environment', *A report of the Center for Strategic & International Studies,* (CSIS), (July 2014) pp.5
[29]Brunner Christian & Soucek Alexander, *Outer Space in Society, Politics and Laws*, (2012) pp.173

of the current development scenario will include extreme new forms of wealth which will dramatically impact the global political economy.[30]

The regime on outer space has resulted in States with innovative space industries being under pressure to enhance their national space interests. Africa's lack of competitiveness in this area results in lesser, or no, pressure on its governments to maintain and forward a stronger position in COPUOS. Though UN Treaties on outer space reflects certain idealism, this is incompatible with the blunt realism of states' space capabilities, and political and commercial interests as clearly demonstrated by Steven Lambakis[31] African States face the possibility of continued marginalisation in space affairs if they continue as passively and reactively as before.[32]

Africa's united front to stop arms races in space would be naive considering that it has barely established a regional space programme. With no space programme and poverty and the many problems facing the African continent, using space for military purposes would put Africa into a completely submissive position dominated by strong space exploring nations. Realists argue that every State should strive to meet its national interest, African States should ensure that they are not caught up with all the technological advances that other countries in the West and East are coming up with to equip themselves with defenses against any threat these states through such advances.

This research incorporates views by Michael Sheehan[33] who discusses about the complexity of establishing outer space activities programmes by states given the political considerations and alliances that exist. A lot of information used in this research has also

[30]Ibid, Weeks
[31]Ibid, Lambakis, pp.39-71
[32] Ibid, van Wyk, pp.27
[33]Sheehan Michael J., *The International Politics of Space: Space power and politics*, (Routledge, 2007)

been through the help of Manzione's book, Multinational Investment in the Space Station: An Outer Space Model for International Cooperation [34] these contain the global development of Outer space activities and investment.

1.6 Justification of the Study

Space is no longer reserved for a few nations. More than fifty nations own and operate space object such as satellites. Reliance on benefits from satellites and other space objects is immense. This especially is due to the advent of Information and Communication Technology (ICT). It is therefore important to understand the relations of Africa in the now very important space matters. The research is intended to start a conversation within the continent to enhance beneficial cooperation for Africa in this newest field. Some of the justified reasons for this study are:

1.6.1 Contribution to Academia

There is little knowledge on the outer space relations that Africa is involved in. This project enhances knowledge on the same and explore opportunities in the intra-African relations that will inform future decisions. There is also very limited literature in regards to outer space activities in Africa not to mention the continent's International relations aspect of the same. This study therefore provides a base for future studies on the same.

1.6.2 Contribution to Policy Formulation

Findings of this research are expected to positively influence the Policy makers in African states and even at the AU level to prioritize funding of outer space cooperation

[34] Manzione, Lara L. 'Multinational Investment in the Space Station: An Outer Space Model for International Cooperation?', *American University International Law Review*, Vol 18, No. II (2002) pp.507-535.

initiatives hence move Africa from consumer of space technologies to a global player in the conception of space technologies. The research is also expected to stir up discussions on how African governments can to increase the capacities of their experts to value the outer space projects launched from their territories and therefore have a say on what programme should be launched on their land and even negotiate on the returns.

Given that space science also has a political bearing, African policy makers should emphasise on some of the common ground priorities that are beneficial to all participating countries and that the programmes drawn up are workable and will effectively be implemented. Policymakers should look at successful space projects, such as Cape Peninsula University of Technology's (CPUT) satellite launch,[35] and see how such activities can be encouraged, while adding value by bringing together continental activities and growing the African space market.

1.7 Theoretical Framework

This study employs the realist theory of international relations. The realist theory argues that States are always engaged in a struggle for power and that the cooperation and coalitions they make in this regard is only but to enhance their interest.[36] The theory further states that for the sole objective of the survival of a state, which is the key most important ambition, a state will opt to cooperate with other states but simply to ensure its survival.[37] In this regard, countries and regions pursue technologies to enhance their domestic and international position. No wonder, outer space activities has been key to

[35]Nodling Linda, Jan 17, 2014, http://www.scidev.net/sub-saharan-africa/policy/analysis-blog/africa-analysis-issues-space-policy-must-address.html#sthash.NBLrwEK2.dpuf
[36] Ibid, Morgenthau, pp. 3-5
[37]Waltz Kenneth M., *Theory of International Politics*, (Reading, MA: Addison-Wesley, 1979) pp.17-27

America's position as a world leader.[38] Some of the factors attributed to maintenance of the United States as a world leader is directly linked to Space programmes[39] for example leading the world in high technology (Silicon Valley), finance and business (Wall Street), higher education (17 of the top 20 universities in the world as per the Shanghai's Jaotong University survey) and first World trade profile (massive exports of consumer and technology goods and imports of natural resources).

According to Robert Pfaltzgraff in his exploration of the growing interrelationship between realist theory and space power,[40] realist theory can be examined in each of its three major variations. These include classical realist theory as set forth by Hans Morgenthau;[41] structural realist theory developed by Kenneth Waltz;[42] and neoclassical realist theory by Gideon Rose among others.[43] Among the key variables of all the three forms of realist theory are the concepts of power and competing national interests in a world of anarchy, with states comprising an international system that requires them to rely extensively on their own means of survival or to join alliances or coalitions with others sharing their interests like the African states have had to do.

According to the classical realist theory, a State pursues its national interest defined by a variety of factors such as geography, ideology, resources, and capabilities

---

[38] H.E. President Barack Obama, *Speech on Space exploration in the 21st Century*, John F. Kennedy Space Center, Merritt Island, Florida, 15 April 2010, 2:55P.M.
[39] Ibid, Lambakis, pp. 39-71
[40] Robert Pfaltzgraff is the Shelby Cullom Davis Professor of International Security Studies in The Fletcher School at Tufts University. Editor's note: This article originally appeared in "Toward a Theory of Space power: Selected Essays" published by National Defense University (NDU) Press.
[41] Ibid, Morgenthau, pp. 3-15
[42] Ibid, Waltz pp. 17-27
[43] Rose, Gideon, 'Neoclassical Realism and Theories of Foreign Policy', *World Politics*, Vol. LI (October 1998), pp.144-172
Zakaria Fareed, 'Realism and Domestic Politics', *International Security*, Vol XVII, No. 1 (Summer 1997), pp.162–183
Glaser Charles L., 'Realists as Optimists: Cooperation as Self-Help', *International Security*, Vol XIX, No.3 (Winter 1994/1995), pp.50–90

based on the need to ensure its survival in a world of anarchy. Because international politics is a struggle for power, it can easily be concluded that space power is a manifestation of such a struggle. With the advent of space technologies, national interests now includes space. This informs why African countries individually are now establishing their independent national space agencies and initiatives.

Classical realism is about how States deal with each other on earth and if international rivalries on earth are being projected into space, then the same theory can also be extended into space. Africa is therefore viewed through the lenses of either trying or failing to position itself in the globe in regards to its development in the crucial Outer space sector.

States need to protect themselves from any external threats of other states or even terrorist groups capable, for example, of destroying or disabling vital infrastructures in telecommunications, transportation, and banking and other financial infrastructures, and food production and distribution systems.[44] Such a threat would arise from a nuclear weapon detonated above the earth's surface. However, States best able to safeguard their earth-bound interests through the exploitation of new technologies are also likely to be able to utilize space for that purpose.

Adherents of the realist theory view space as the new frontier that will be exploited as part of an inevitable and enduring struggle for power. More than forty years ago, President John F. Kennedy expressed this idea when he declared, "The activities of space will go ahead, whether we join in it or not, and it is one of the great adventures of all time, and no nation which expects to be the leader of other nations can expect to stay

[44]This type of threat is described and discussed in the Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack, vol. 1, Executive Report (2004).

behind in the race for space."[45] In the absence of space leadership, states will lose preeminence on earth. In recognition of this essential fact, competition in space began as soon as technologies became possible. During the Cold War, the Soviet Union challenged the United States in space.

After the cold war, there is an increase in the number of States whose power and prestige has been enhanced by their space programmes. The advent of space technologies has therefore added this new dimension of Space to the national interest concept of realist theory. Developing countries including those in Africa that cannot afford resources to space or that simply lack such capabilities are more likely to favor the extension of the common heritage principle to space while attempting to place drastic limits on developed countries and perhaps calling for mandatory transfers of space technology to developing countries. Such countries view space through a different prism of national interest, seeking to restrict or retard more developed states even within their region for example South Africa and Nigeria in Africa from exercising full control or from maximizing space power. Such behavior on the part of states large and small with regard to space issues is in keeping with realist theory. Each state operates according to perceptions of national interest.

Structural realist theory offers other insights into future space relationships. According to Kenneth Waltz, the international structure shapes the options available to states. Levels of interdependence have increased greatly. The foreign policy options available to states differ between bipolar and multipolar international systems. Structure shapes how states align with or against each other. States will strategically position

[45]H.E. John F. Kennedy, *America's Space Effort*, (address at Rice University, Houston, Texas, September 12, 1962)

themselves into space if they have not already started doing that and this provides an important basis for theorizing about their relative importance themselves, other states and regions. Space activities and exploitation will create interactive patterns and power relationships. Space control is held by many to be indispensable to power on earth. Space power will therefore become the essential basis for earth power. This is why any country that has a positive economic development track record including those in Africa strive to be represented in space as well.

Neoclassic realism is also viewed in the way African states desire to form a coalition to secure their interests. There have also been concerted efforts and calls from African States fronted by the AU, for the formation of AfriSpace, a pan-African space agency to gradually mark their own regional space ambitions. There are arguments that if Africa doesn't arise and take charge of its international relations strategies and policies in outer space and things are left to the current paradigm of western powers, outer space activities from Africa will go the same way as minerals, oil and gas have, where the global powers wrestle control of vital resources leading to further chaos and conflict as can be seen in the continent.

In 2010 the African Union controversially approved a feasibility study for the creation of an African Space Agency that led to the AU Ministers Summit decision to draft a common space policy for the AU member states in collaboration with the International Telecommunication Union (ITU) and the United Nations Economic Commission for Africa. In 2012, the Sudanese president, Omar Hassan al-Bashir reiterated this and said "Africa must have its space agency that will liberate Africa from

the technological domination of the West".[46] Space politics is therefore influencing national and regional agendas.[47]

1.8 Gaps in the Literature Review

The availability of literature on International relations in regards to Outer Space activities is very limited but even more so in relation to Africa. The literature available has not expounded more on Africa and in fact seem to continue the international portrayal of a negative image of the continent by dismissing any positive initiatives in relation to innovations and technologies from outer space for example the positive strides that African countries have made in the area of telecommunications. Most of the literature also dwells more on a few independent space fairing African States like South Africa and Nigeria as opposed to a regional outlook of the continent in this area.

1.9 Hypotheses

The following assumptions were made in relation to the study:

1. Africa's contribution in the outer space activities is minimal
2. The bilateral and multilateral agreements on outer space that Africa is party to are not reciprocal; and
3. There are many challenges facing Africa's relations with other state and non-state space actors. An example is the perceived existence of conflict of interests in its engagements with these actors as a region and also as independent sovereign states.

[46]Smith David, African correspondent, *Sudanese president calls for African space agency*, September 6, 2012, https://www.theguardian.com/world/2012/sep/06/sudanese-president-african-space-agency

[47]Cadbury Deborah, *Space Race*, (Harper Perennial, Reprint edition, 2007), Hogan Thor, National Aeronautics and Space Administration, *Mars Wars: The Rise and Fall of the Space Exploration Initiative*, (Government Printing Office, 2009) & Kissinger Henry, *Diplomac*y, (Simon & Schuster; Reprint edition 1995) show how nations frame their interactions with one another, how space politics influences national agendas, and the political history surrounding the evolution of rocket technology.

1.10 Research Methodology

This section outlines the study process and describes how the entire research was carried out. It describes the study approach, sampling design, types of data used and their sources, collection tools, data collection process and data analysis used during the study.

1.10.1 Research Design

The research employed a mixed method approach of case studies and surveys. The case studies were ideal for providing a holistic, in-depth investigation [48] as expounded by author Yin.[49] To ensure validity, the study used several sources of data collection, and these included document reviews and key informant interviews.

The study also employed a multidisciplinary approach of several aspects related to space science and economic development but mainly dwelt on International relations. The audience of this research therefore vary from the African Union, to the specific member states within the union, policy makers in the area of space science and technology, International relations experts and students. Data on Africa's relations with other space actors was obtained from agreements, treaties and joint programmes of a few African states with other state and non-state space actors. This information helped in understanding the nature of relations that Africa is involved in regards to outer space activities. Case studies on some of the existing space initiatives in Africa were also analysed to identify the trends showing success or failure to be able to draw out the challenges and opportunities for further growth. The research instruments were developed after an extensive review of literature to ensure they captured the relevant information and maintain uniformity throughout the study.

---

[48] Feagin, J., Orum, A., & Sjoberg, G., *A case for case study*, (Chapel Hill,NC: University of North Carolina Press 1991)

[49] Yin, Robert K., *Case Study Research: Design and Methods, 3rd edition*, (Thousand Oaks, CA: Sage Publications, 2003)

1.10.2 Data Collection

The research used a mixed method approach of data collection by examining both primary and secondary data to obtain a deeper understanding of the key issues that the study sought to find out. Primary data was obtained through administration of semi structured questionnaires to key informants physically and also through e-mail from the following institutions: African Union (Officials from the Human Resources, Science and Technology), Morocco, Nigeria and South African, American, EU, Chinese and Indian Diplomatic Missions, Ministry of Foreign Affairs of Kenya (Diplomats/officials in the area of International Affairs), South African National Space Agency, the African Regional Centre for Space Science, National Council for Science and Technology (NCST) of Kenya, Kenya Meteorological Department (KMD), Kenya National Space Secretariat (NSS) and the Kenya Defence Forces. Questionnaires were preferable because they were cost effective as they were able to provide information from a large literate sample in a short span of time and at a reduced cost.[50]

The questionnaires for this study were two. They mainly consisted of structured questions that appear in Appendix iv and v. The first questionnaire had 20 questions while the second questionnaire has 19 questions. Both had factored all the identified parameters under investigation: number of space launches, budget of space programmes, capacity building and information sharing. Sixty questionnaires in total, that is, thirty for each of the two were adequately administered physically and through e-mail with 95% response rate. The questionnaire was administered through the respondents voluntarily recording their responses in the questionnaire then physically returning it back or

[50]Mugenda O.M. & Mugenda A.G., *Research Methods Quantitative and qualitative approaches*, (Nairobi: Acts Press, 2003)

scanning and emailing it back to the researcher. This is because the subject matter and the key informants selected had all to be knowledgeable in the area of study hence literate. Descriptive data obtained from the questionnaire was then analysed to generate this report.

Secondary sources of data included books, journals, internet articles like the UNOOSA website and austranautix.com, reports and circulars on outer space related activities in Africa. The study further analysed a few case studies of international treaties, declarations and resolutions pertaining to outer space and scholarly articles connecting these to international politics involved in the various negotiations and ratifications of these international legal instruments.

1.10.3 Sampling and Population of the Study

The population of the study was all the Fifty four states in the African continent. The study employed stratified sample of the study population through dividing the African continent into four stratums namely; Northern, Southern, Eastern and Western. One country was then identified from each of the four regions to ensure each region was represented: Morocco in the Northern region, South Africa in the Southern region, Kenya in the Eastern region and Nigeria in the Western region. These four countries were specifically selected due to their advanced national outer space initiatives that made them stand out in their regions.

1.10.4 Data Analysis

Qualitative data collected from the key informants was recorded into a computer and analysed. These analysis involved establishing keywords, phrases as well as ideas that helped to answer the research questions. The whole study was conducted

in a period of seven moths starting from January and finalized at the end of July, 2016. The research was conducted upon obtaining the required authorization from the University of Nairobi, Institute of Diplomacy and International Studies.

1.11 Limitations and Scope of the Study

The study of space and International relations falls in two fields: science and technology and International relations. Activities related to the activities and exploitation of the outer space are therefore a source of interdisciplinary and transdisciplinary research[51]. This research however focused on the International Relations aspect related to outer space activities initiatives in Africa and not the physical science involved.

Some of the challenges encountered during this research included limited academic books addressing the relations of outer space in Africa. Instead, there were numerous non-academic website articles and journalistic reports on outer space initiatives particularly in South Africa and Nigeria. There was collection of more data than had been anticipated and this took more time to sift through for relevant information on Africa.

There was also the unavailability and unwillingness of some of the key informants to divulge information they deemed confidential about their counties' agreements though provision of the relevant authorization to conduct the study was helpful. In the course of the research, there was also the realization that area of study that is International Relations of Africa in Outer space was too wide. The three objectives were therefore not fully exhausted with the given timeline and limited resources and it is therefore recommendable that in future each of these objectives form a study topic for better understanding of Africa's relations on outer space.

[51]Roberts Darryl. 'Space and International Relations', *The Journal of Politics*, Vol L, No. 4 (1988) pp.90 http://www.jstor.org/stable/2131393.

1.12 Research Ethics

This study applied the ethical considerations mentioned below throughout the data collection and analysis to enhance the quality and integrity of the research and also to ensure that the findings are independent and impartial.

1.12.1 Professionalism

Approval to collect both primary and secondary data on cooperation in outer space activities in Africa was sought from the Institute of Diplomacy and International Studies at the University of Nairobi as required by the Kenya National Commission for Science, Technology and Innovation. Participation in the research was completely voluntary. The participants had a right to withdraw from involvement in the research at any time and they were provided adequate information on the interviewer and the purpose of the research.

The research was not funded by any sponsor apart from the researcher. Therefore, there was no conflict of interest in relation to the objective and impartial treatment of the data. Data collected from the research especially from the interviews was secured and precautions taken to prevent the leaking of the confidential information and the findings only presented in this report. The findings presented the real situation regarding outer space relations of the sampled countries as a representation of the African continent. The research findings may at a later date be shared with the relevant Kenyan legislation on research as well as to the relevant AU and international stakeholders.

1.13. Outcomes

The outcomes of this research are outlined in chapters two three and four. Chapter two addresses the Intra African cooperation in Outer space through a description of the findings of the general development of Science and technology in the continent. This

chapter also reports on the findings from analysis of the sampled bilateral and multilateral agreements between and among African states in relation to outer space, questionnaires administered to key informants from relevant institutions and the case studies from reports and articles on outer space initiatives in the four sampled countries.

Chapter three looks at the extent and scope of Africa's relations with other State and non-State Space actors. Findings classify relations in capacity building, access to information and data sharing and technical assistance and technology transfer. This chapter also involves an analysis of bilateral and multilateral agreements between African states and other external state and non-state actors, interviews administered to key informants in sampled diplomatic missions, International Organisations and of reports and books with relevant information.

Chapter four explores the challenges that Africa faces in its International relations with other State and non-State space actors. Finally, chapter five provides conclusions of the study, gives recommendations and suggest areas for further study. A summary of the final report was scheduled to be provided to the African Union department of Science and Technology and the relevant authorities in the Government of the Republic of Kenya.

CHAPTER TWO

INTRA AFRICAN COOPERATION IN OUTER SPACE

2.0 Introduction

This chapter outlines a detailed account of the Intra African cooperation in Outer space through a descriptive statistical and analysis of all the factors that were under investigation. These included exploring areas of cooperation in relation to research, policy formulation, setting up regional platforms and joint initiatives related to outer space initiatives in Africa.

2.1. Cooperation of African States in Space Research

This study established that there are less than ten key players in outer space initiatives[52] hence outer space research in Africa. In this regard, most of the countries without any established space agencies in Africa depend on the less than ten countries for the findings and innovations obtained from space activities. This is in consistency with a presentation by SANSA,[53] revised a classification of space fairing African nations into the table below.

Table 2.1: African countries engagement in Outer space compiled by the researcher with data collected from a presentation made by SANSA at the AMSIR workshop in Boston

Description of country	Country names	Level
Countries with fully established Space Agencies and satellites	Nigeria, South Africa, Algeria, Egypt, Morocco & Tunisia	3
Countries with fully established Space Agencies but no satellites	Kenya, Uganda, Ethiopia, Ghana, The Sudan	2
Countries with no Space Agencies or satellites but with laid out plans on outer space initiatives	Botswana, Angola, Zambia	1
Countries with no space Agencies, satellites or any laid out plans on any outer space initiatives	All the others	0

[52] These are Nigeria, South Africa, Algeria, Egypt, Morocco & Tunisia

[53] Mckinell L., *Space Science Research in Africa*, (SANSA, 2013) http://www.bc.edu/content/dam/files/sites/amisr/presentations/F0900_McKinnell_AMSIR-workshop-Boston.pdf

Level 3 countries in the table have launched their own satellites into the earth's orbit and have established space agencies. These are more advanced in the area of space research compared to the other countries. These countries. Countries in Level 2 and 1 are catching up and have upcoming initiatives while level 0 that contains the majority countries have not indicated any laid out plans for space initiatives or space research.

This study was also able to identify that although many African States do not have established space agencies, the following regional training centers of excellence serve not only the host countries but also the other States located in their regions:

Table 2.2: Regional Training Centers of Excellence compiled by the Researcher using data from UNOOSA

Space Research center	**Location/country**	**Focus**
Regional Centre for Mapping of Resources for Development (RCMRD)	Nairobi, Kenya	Mapping of Resources for Development
Regional Centre for Training in Aerospace Survey (RECTAS)	Ile-Ife, Nigeria	Aerospace Survey
Regional Centers for Space Science and Technology Education in English	Nigeria	Space Science & Technology Education
Regional Centers for Space Science and Technology Education in French	Morocco	Space Science & Technology Education

The above table indicates that though the number of African countries with fully developed space research institutions and programmes are few, there is some progress to develop their capacity building in space science and technology especially through the regional training centers of excellence.

The study further determined that another avenue for cooperation among African States in space research is through the Pan African University[54] established by African

[54] AfricaSTI, African Union launches Pan-African University, Africa Science Technology & Innovation News, Dec 21, 2011, http://www.africasti.com/lead-stories/african-union-launches-pan-African-university

Union in 2015. This consists of post-graduate training and research network of university nodes in five regions, among them being the Pan African University Institute for Space Sciences (PAUSS) hosted by South Africa.

The study also found out that Africa hosts the Intergovernmental Authority on Development (IGAD) Climate Prediction and Application Centre (ICPAC) has Burundi, Djibouti, Eritrea, Ethiopia, Kenya, Rwanda, Somalia, Uganda, South-Sudan, Sudan, and Tanzania as its member countries. The institution based in Nairobi was established by IGAD member in April 2007 to strengthen the region's capacity to predict climate-related disasters. The institution monitors regional temperature variations and also establishes weather pattern predictions, based on data from US and European satellites. In 2007, ICPAC was estimated to have an annual budget of US$500,000, with each of the ten countries involved contributing US$50,000 each year to its basic operational budget.

The study established the following as achievements of ICPAC: [55] timely production and dissemination of climate early warning information, improvement of knowledge of processes and new empirical models for seasonal forecasts, establishment of a continuously updated data bank for development of baseline statistics and hazards maps, successful networking with users of climate information, climate scientists and media groups in dissemination of weather information and products and several recognitions and awards at regional and global levels. The center contributed to IPCC 2007 assessment that won the 2007 Nobel Prize. Africa has also hosted several basic space science training workshops and public awareness programmes through the

[55] IGAD Climate Prediction & Applications Centre (ICPAC) available at http://www.icpac.net/. Accessed on July 21, 2016.

United Nations Programme on Space Applications and other UN agencies. All of these efforts have provided platforms for cooperation in space research, in Africa.

2.1.1 South Africa's Cooperation in Space Research

South Africa is a partner with several other African countries in space research. The study was able to find out the following partnership projects undertaken by South Africa with other African States:

Table 2.3: Partnership projects undertaken by Africa and other African States compiled by researcher using data obtained from SANSA

Project	**Partner State**
Modelling space weather effects using GPS and scintillation	Kenya
Modelling the global peak ionosphere electron density	Nigeria
Investigation and modelling space weather studies over Africa	Zambia
Interagency cooperation in space science and technology	Algeria
The Square Kilometer Array project (SKA)	Endorsed by African union to be hosted in South Africa

The above table shows only a handful of partnership projects between South Africa and other African States. In comparison to the relations the country has with Non-African States,[56] this study established that South Africa has more relations in space activities with non-African States compared to African states. However, projects like the Square Kilometer Array project (SKA) is a perfect opportunity to enhance the development of Africa's scientific capacity, research efforts and industrial development.

[56] Statement by Mr. Magen Govender, Counsellor, Permanent Mission of the Republic of South Africa to the United Nations on International Cooperation in the Peaceful Uses of Outer Space on 19 October 2012 available at http://www.southafrica-newyork.net/speeches_pmun/view_speech.php?speech=5706622. Accessed on July 15, 2016.

In addition, South Africa has a variety of institutions in academia, the science councils and industry that play a significant role in the scientific study, activities and utilisation of space. These institutions have broad competencies in space technologies such as infrastructure and skilled workforce, making South Africa to be a regional hub of space science and technology. In this regard and also considering that South Africa has also hosted several international space events such as the 62nd International Astronautical Congress (IAC) in Cape Town in 2011, this potential and experience is a huge advantage to the African continent and can be used as a basis to develop links with South Africa to enhance the continent's capacity in outer space activities.

2.1.2 Nigeria's Cooperation in Space Research

National Space Research and Development Agency (NASRDA is one of the research institutions under the auspices of the Federal Ministry of Science and Technology of Nigeria with a mission to pursue the research and development of space science and technology. Nigeria through NASRDA supports Institutions in Africa with data for research. Nigeria also serves as the regional support office of the UNSPIDER project and has also been involved in other key space projects in Africa such as Group on Earth Observations (GEO) and ARMC.

Nigeria seeks to establish regional leadership in space as part of its overall science and technology strategy through participating in the most prominent regional space initiatives. Nigeria is also involved in a number of international space-related initiatives such as the UN Committee on the Peaceful Uses of Outer Space (COPUOS) to the GEO. Through *NigeriaSat-1*, Nigeria is also a member of the Disaster Management Constellation (DMC), an international collaboration between five countries with SSTL-

built satellites to create remote sensing data products for disaster relief and resource management purposes[57].

This research established that just like South Africa, Nigeria has more external partners in outer space activities compared to those from Africa. Moreover, capacity building through partnerships with more advanced space actors has been a key feature in Nigeria's space programme. This approach appears to be working for Nigeria, in terms of acquiring national satellites for addressing the needs of its people. NASRDA and other government entities are reportedly using remote sensing data from NigeriaSat-1 to address a variety of national development challenges.[58] However, Nigeria has yet to develop domestic facilities and industries for indigenous satellite manufacturing and launch. Given the current status of the Nigerian space programme, as well as its limited budget, it appears that Nigeria must continue its strategy of using international partnerships to fulfill its space policy, at least in the near term. Nigeria is open to cooperate with foreign commercial space companies could indicate future trends.

2.1.3 Morocco's Cooperation in Space Research

Although Morocco does not have its own national space law, it has already ratified 4 of the five UN Space Treaties and is a COPUOS member since 1961. Morocco's space program is coordinated by the Royal Center for Remote Sensing, which was established by royal decree in 1989. In 2001, Morocco collaborated with Germany to produce the Maroc-Tubsat remote earth sensing satellite. The African Regional Centre for Space Science and Technology, in French Language (CRASTE-LF) was initiated in Morocco in 1998.

[57]Boroffice, R A., 'The Nigerian Space Programme: An Update', *African Skies*, Vol. XII (2008) pp.40- 45
[58]Akinyede, J O, & G I Agbaje. 'Remote Sensing: From Pixels to Processes', *Proceedings from ISPRS*, VOL XXXVI, (Enschede, Netherlands, 2006)

This study established that Morocco is becoming more and more active in Space Activities among the North African countries. However, the country does not seem to have any meaningful bilateral relations related to outer space cooperation with other African countries particularly those located in sub-Saharan Africa. Morocco has competences in micro-satellites but it is focusing in particular on Remote Sensing. The Royal Center for Space Studies and Research (CRERS) is in charge of the space technology and the Royal Centre for Remote Sensing (CRTS) is responsible for the development of capacities at the national level, the coordination and execution of the national programme of Remote Sensing and the provision of training and education opportunities in space technologies.

Morocco has always been faced with problems of floods and earthquake. In this regard, the country through its Rabat based Royal Centre for Remote Sensing (CRTS) supports space cooperation projects in marine resources management and forest resource management. The Moroccan Association of Remote Sensing of the Environment (MARSE) is a non-profit association, created in 2011 and is the link between the research sector in the university and the socio-economic environment. Its goal is to promote research in environment and sustainable development, through various communication means such as scientific meetings, support of young researchers and establishment of relations, coordination and exchange of experiences with other organizations such as associations, industries, and universities within Morocco and also across Africa.

2.1.4 Kenya's Cooperation in Space Research

Kenya does not have an established space agency like South Africa, Nigeria and Morocco analysed above. However, the country is a recipient of majority of the space projects in Africa because of among other reasons being an equatorial State, it is an ideal site to efficiently launch satellites into geostationary and other orbits. Kenya is also a member of important global organizations involved in space science and technology such as the International Telecommunication Union (ITU), United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS), World Meteorological Organization (WMO) and the United Nations Environmental Program (UNEP) among others. In 2009, Kenya established the National Space Secretariat of Kenya. This body was to conduct or coordinate space-based researches, and update Kenya space science policy; initiate training aimed at ensuring adequate transfer of space technology and its applications; promote peaceful uses of space science applications including, but not limited to, satellite earth observations, navigation, telecommunication and disaster management; oversee the transition of the Secretariat into a fully-fledged Kenya Space Agency; and enter into association with other agencies within and outside Kenya for purposes of research, data acquisition and application in the field of space science.

Kenya is already engaged in the affordable Space Technology Applications (KOASTAL) project in its Coast Observation to detect and monitor marine and terrestrial water pollution. The new space programme could also enhance opportunities for intra-African co-operation, as provided for under the Constitutive Act of the African Union (AU). Kenya also plans to set up a space center with earth observation satellites to boost the country's security as well as provide solutions in the agriculture, education and medical sectors. In addition to Nigeria, South Africa and Algeria as the only other

countries in Africa with earth observation satellites, Kenya is set to become a contributor to the development of space technology in the continent and also globally.

2.2 Policy Formulation

This research established that space policies in Africa are not advanced compared to those of other regions globally. Furthermore, Africa did not have any unified outer space policy in outer space until after 2000 when the continent readdressed its focus from the Organization of the African Unity (OAU) to the socio-economic development driven African Union (AU). The establishment of the AU also led to the formation of the New Partnership for Africa (NEPAD), the technical arm to implement the AU policies. Recognizing the value of science and technology as important drivers of development, the AU then developed the Consolidated Plan of Action for Science and Technology (CPA) consisting of a number of flagship projects among which was Space Science.

In 2012, the African Union Commission established a Space Science Working Group at the request of the African Ministerial Committee for Science and Technology (AMCOST). This working group consisted of representatives of member states from all five regions in Africa and it was to come up with an African Space Policy and an African Space Strategy that would be a framework for enhancing the development of outer space sector in Africa. In early 2016, the African Union Heads of State and Government approved the African Space Policy and Strategy during their Twenty-Sixth Ordinary Session held in Addis Ababa. The space policy and strategy contains goals for the continent to develop relevant institutions and capacities for socio-economic benefits for her people from space technologies.

Independently, several African states have developed their own independent national space policies. Nigeria for example approved its space policy in 2001 through which its National Space Council was established. South Africa on the other hand has four space policy instruments, namely: the National Space Policy, the National space Strategy, South African Earth Observation Strategy and the South African National Space Agency Act. It's through its National Space Agency that South Africa fosters international cooperation in space related activities. The South African National Space Policy provides the main guidance for the conduct of space activities to be carried out in support of national and regional priorities.

Out of the sixty respondents of both questionnaires that were administered during this study, forty stated that policy making in Africa was way behind compared to the level of space technology present therefore many new space activities are not directly addressed by the existing legal structures.

2.3 Regional Platforms in Relation to Outer Space

This research established that several regional forums exist in Africa in relation to outer space activities. One such forum is the African Leadership Conference on Space Science and Technology for Sustainable Development (ALC).[59] This is an important regional forum that aims to raise awareness among African leaders of the importance of space science and technology, provide a regular forum for the exchange of information among African countries and enhance intra-African cooperation in the development and application of space technology. Membership of the ALC is open to all African countries. Below is a table recording the venues of all the ALC Conferences.

[59] Martinez, Peter, 'The African Leadership Conference on Space Science and Technology for Sustainable Development', *Space Policy*, Vol XXVIII, No. 1, (2012) pp. 33-37

Table 2.4: ALC Conferences compiled by the researcher from http://www.space.gov.za/conferences/

Host Country	Year of conference
Abuja, Nigeria	2005
South Africa	2007
Algeria	2009
Kenya	2011
Accra, Ghana	2013
Sharm El Sheikh, Egypt	2015

Another regional forum is the African Regional Center for Space Science and Technology Education in English located at Ile-Ife, Nigeria. The center provides training in remote sensing and GIS, Satellite communications and satellite meteorology to participants from 17 African countries.

Monitoring for Environment and Security in Africa (MESA) forum is also a platform for ensuring continuity of past investments on the use of Earth Observation data in Africa. The forum is one of the tools for sharing information and gathering feedback from the MESA programme that uses data acquired from space to enable an improved management of the environment and food security at continental, regional and national levels in Africa. Countries that benefit from the MESA program are 48 ACP countries within the five African regions, namely CEMAC, ECOWAS, IGAD, IOC and SADC. The African Union Commission is the contracting authority of MESA.

2.4 Joint Initiatives

One of the joint initiatives in the area of space research in Africa is the African Resource Management Satellite Constellation (ARMC). This was a key collaborative outcomes of the ALC that was a joint project of four states: Nigeria, Algeria, Kenya and South Africa to develop a constellation of satellites to provide real time data for environmental and resource management in Africa. Data from the satellite was

received by an integrated ground station then transmitted to end users throughout the continent.

In 2010, the first successful launch of a pan-African satellite by the Regional African Satellite Communications Organization took place.

The following table indicates some of the major space projects across Africa:

Table 2.5: Major space projects in Africa compiled by the researcher using data obtained from GMES and Africa Action Plan (GAAP)

Project	**Focus**	**Number of African countries**	**Funding**
AMESD	Earth observation	AU	EU, AU, RECs. AMCEN
PUMA	Meteorological and Hydrological services	54	COMESA, ECOWAS, IGAD, SADC, ECCAS. EUMETSAT
GMES now known as Copernicus	Earth Observations on environment and Security	6	EU
GEOSS	Global Earth Observations	22	Member Countries & EU
African Caribbean and Pacific Observatory for Sustainable Development	Space based environmental monitoring and monitoring of Natural Resources	48	EU & Member countries
Tiger Initiative	Research and geo-information for integrated water management	42	EU, UNESCO, Member countries
The Vegetation for Africa Project	Vegetation data	54	EUMETSAT, EU, AU, SPOT Image
Ocean Data and Information Network in Africa (ODINAFRICA)	Coastal and ocean data and information	25	AU/NEPAD & UNESCO
Climate for Development in Africa	Policy in climate-sensitive sectors and areas of Africa	54	AU, UN UNECA), EU.
Application of Remote Sensing for Integrated Management of Ecosystems and Water Resources Desert	ecosystems and water resources	All	UNESCO

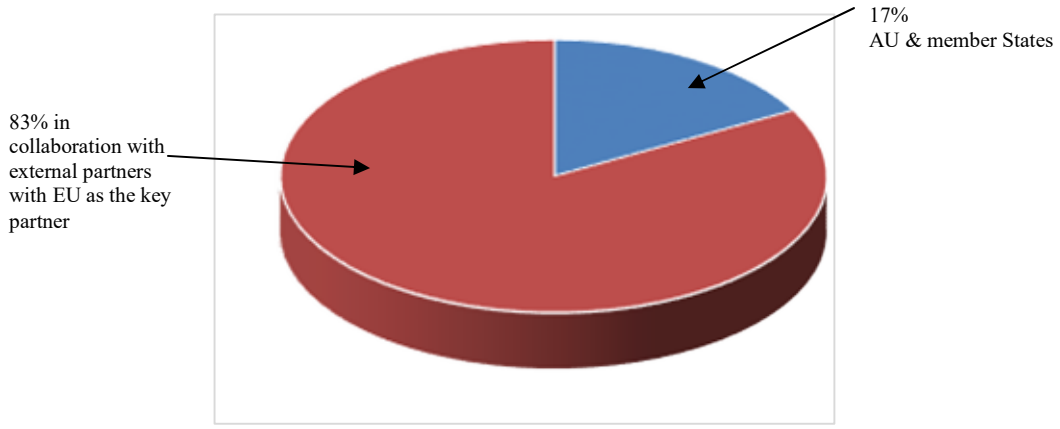
Watch project			
Desert Watch project	Earth observation	-	EU
African Marine Information System	Monitoring in the coastal and marine waters	African Coasts	EU & JRC
Global Monitoring for Food Security	Earth Observations on food security	SADC	UN (FAO, WFP) EU, JRC
Observatory of Central Africa Forests	Monitoring Central Africa forests	10	EC (JRC), FAO,
Portuguese and Spain Satellite for Space Application for Africa: DEIMOS	Resource, environmental and disaster monitoring	-	Portugal
Global Biodiversity Information Facility	Mobilizing bio-diversity data to underpin sustainable development	All -54	Member countries
Bird Life International, Africa Partnership projects	Monitoring birds species and their habitats	22	EC
(UNECA) Geo-information Systems Section projects	Spatial data	All -54	AU & UN
ARM	Earth orbiting satellites to provide a daily African imaging at high resolution	Algeria, Kenya, Nigeria and South Africa	Member countries
GEONETCast	Transmission of data about diseases, drought, biodiversity, natural disasters, air and water quality, ocean conditions, and ecosystems in near real time	All- 54	EUMETSAT, EU
Global Climate Change Alliance	Integrate climate change into development cooperation and poverty reduction strategies	All-54	EU & AU
China Brazil Earth Resources Satellite For Africa	Earth Resources monitoring satellites	South Africa	Member countries
UNESCO-IOC initiatives	Remote sensing based projects including Integrated Management of	African Coasts	UN & AU
OTHER UN AGENCIES	Earth Observation for Early Warning, Environmental	All-54	UN

UNEP (Division for Early Warning), FAO (Early Warning and Food Security projects) and the UN Office for Outer Space Affairs	Monitoring or Capacity building for use of space science		
Regional Ocean Observing and Forecasting System Africa project	Integrated African ocean observing and forecasting and information delivery	29	UN, AU (NEPAD)
African Institute for Space Science	Multidisciplinary research and applications in space science and technologies	All-54	AU
World Meteorological Organization African projects	Global Observation Networks	All-54	UN
SERVIR	Monitoring and forecasting ecological changes and severe events such as fires, floods, volcanoes, storms	All	USA (NASA, USAID); World Bank; CCAD
National Space Agencies in Africa	Earth Observation	South Africa, Nigeria, Kenya & Algeria	Member countries
Global Spatial Data Infrastructure Association	Promoting international cooperation and collaboration in support of local, national and international spatial data infrastructure development	RECS	Member countries

Out of the thirty joint space programmes in Africa indicated in the table above, only five (5) space projects are entirely funded by the member countries or the African Union that accounts close to 17%. This means that even the joint space projects undertaken by African countries, only a few are fully taken care of or funded by the African member States.

The table also shows that out of the 25 space projects funded in cooperation with other external partners, European Union is involved in supporting thirteen (13) projects. Out of these thirteen, three (3) are entirely funded by the Union.

Fig 2.1: Partnership of joint space projects in Africa compiled by researcher using data obtained from Table 2:5 of this research



2.5 Conclusion

Though there is minimal participation of Africa in space related initiatives, a number of African countries are progressively increasing pace for science and space activities. These include: Ethiopia, Nigeria, South Africa, Egypt, Morocco, Tunisia, Algeria, Uganda, Angola, Ghana, and Kenya. There are also efforts for cooperation that will enable countries that are not able to afford space initiatives independently to also benefit from the joint regional projects. However, most of Africa's space programmes are partnered with foreign countries hence limiting their independence and control of data and information generated.

CHAPTER THREE

AFRICA'S RELATIONS WITH OTHER STATE AND NON-STATE SPACE ACTORS

3.0 Introduction

This chapter looks at the extent and scope of Africa's relations with other state and non-state Space actors. Findings are from the analysis of the global collaborations that Africa is a part of, capacity building and information sharing parameters.

3.1. Major Global Space Forums Involving Africa

This research established that though several African States are party to the UN treaties on outer Space, they are very few compared to States in other regions globally.[60] This is indicated in the table below:

Table 3:1 Status of the African countries in the UN treaties on Outer Space Treaty compiled by the researcher using data from UNOOSA

STATUS OF THE UN TREATIES ON OUTER SPACE				
Treaty	**Ratification, acceptance, approval, accession or succession**		**Signature only**	
	All countries including Africa	**African States only**	**All countries including Africa**	**African States only**
Outer Space Treaty	104	21	25	10
Rescue Agreement	94	17	24	5
Liability Convention	92	14	21	7
Registration Convention	62	7	4	0
Moon Agreement	16	1	4	0

[60] United Nations Office for Outer Space Affairs, as at January 2016 available at http://www.unoosa.org/documents/pdf/spacelaw/treatystatus/AC105_C2_2016_CRP03E.pdf. Accessed on August 4, 2016

The table above can be generated into the graphs below.

Fig 3.1: Ratification, acceptance, approval, accession or succession of UN Treaties on Outer Space drafted by the researcher with data from United Nations Office for Outer Space Affairs, as at January 2016

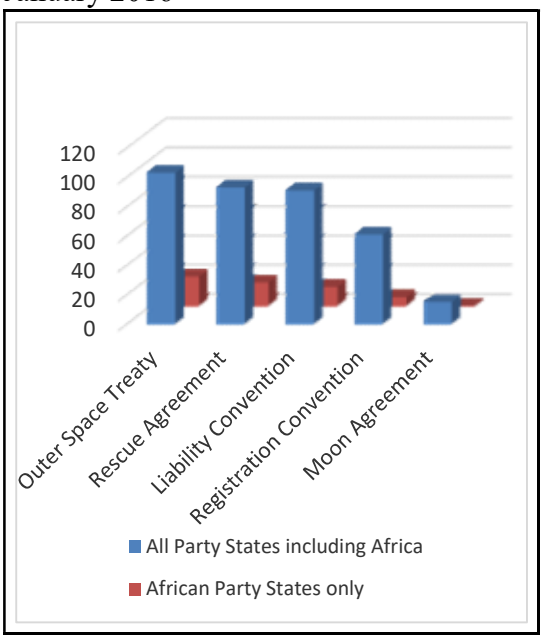
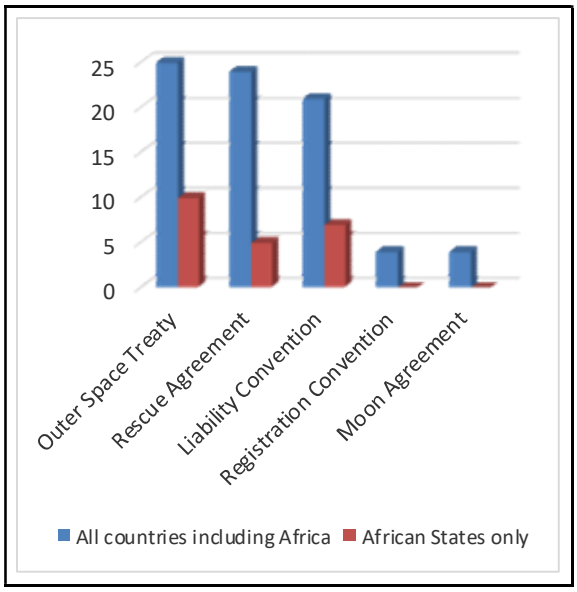


Fig 3:2: Signatures only of UN Treaties on Outer Space drafted by the researcher with data from United Nations Office for Outer Space Affairs, as at January 2016



The graphs clearly indicate the minimum involvement of African countries in the ratification, acceptance, approval, accession or succession and even the signing of UN treaties on outer space. However several African states are party to the Outer Space Treaty which is the main treaty that provides the basic framework on international space law. This indicates that African governments are finally coming around to understand the critical importance of Outer space activities as instruments for development. This can partly be related to some appreciation among Africa's political leadership of the important role of space science and technology as a motor of socioeconomic development. However the status indicated in the graphs regarding the UN treaties on

outer space can also be attributed to the challenges that have been explored in chapter four of this study.

This research identified that African States are also party to the following major international forums on outer space:

3.1.1 United Nations Committee on the Peaceful Uses of Outer Space UN COPUOS

Committee on the Peaceful Uses of Outer Space (UN COPUOS) is the primary international forum for the development of laws and principles governing activities in outer space. The committee was set up by the General Assembly in 1959. The Committee was tasked with reviewing international cooperation in peaceful uses of outer space, studying space-related activities that could be undertaken by the United Nations, encouraging space research programmes, and studying legal problems arising from the exploration of outer space. Out of the 83 Member States of the COPUOS only 17 states are from Africa.[61]

The study observed that there was a low level of involvement by African countries in the activities of the COPUOS, especially its Legal Subcommittee. This is despite the fact that ratification of and compliance with UN space treaties was a means to ensure that space would be preserved for peaceful fair and responsible uses, to the benefit of all nations.

3.1.2 United Nations Conference on the Outer Space (UNISPACE)

The first United Nations Conference on the outer space was held in Vienna in 1968. This was because by then, the rapid growth of space technology and its potential

[61] Members of the Committee on the Peaceful Uses of Outer Space. Available at http://www.unoosa.org/oosa/en/members/index.html. Accessed on 2 August 2016

for important applications was already clear.[62] So far there have been three such conferences. Below is a table comprising of the conferences ever held and the representation of participation by African States:

Table 3.2: UNISPACE Conferences compiled by the researcher from UNOOSA website

Year	UN Conference on the Exploration and Peaceful Uses of the Outer space	Number of States represented	African countries represented
1968	UNISPACE	78 Member States, 9 specialized UN agencies and 4 other international organizations	7- Algeria Kenya Liberia Libya Senegal South Africa Uganda
1982	UNISPACE II (UNISPACE 82)	94 Member States and 45 intergovernmental and non-governmental organizations.	19
1999	UNISPACE III	97 Member States, 9 UN specialized agencies and 15 international intergovernmental organizations	24

3.1.3 United Nations Platform for Space-based Information for Disaster management and Emergency Response (UN-SPIDER)

This is a platform under United Nations Office for Outer Space Affairs (UNOOSA) which facilitates the use of space-based technologies for disaster management and emergency response. UN-SPIDER established Regional Support Offices (RSOs) and National Focal Points (NFP) through the UN general Assembly Resolution 61/110, these form a global network to foster and strengthen strategic

[62] Space Exploration and Applications: Papers presented at the United Nations Conference on the Exploration and Peaceful Uses of the Outer Space, Vienna, Aug. 14-27, 1968 (United Nations, Sales No. E.69.1.16, vol. I and II)
Tiyanjana Maluwa, International Law in Post-Colonial Africa: Studies and Materials on the Settlement of International Disputes, V. 4, Martinus Nijhoff Publishers, 1999, p. 408

alliances and partnerships on a global and regional scale. In Africa, UN-SPIDER has Regional Support Offices in Algeria, Kenya and Nigeria.

3.1.4 The International Academy of Astronautics' (IAA)

The IAA has been sponsoring regional conferences and meetings focusing Africa's emerging space exploration capacities and aspirations. Examples are four regional conferences on space in Africa all held in Abuja, Nigeria.[63] Two important high level meetings in 2011 also sponsored partly by IAA were, the 4th African Leadership Conference on Space Science and Technology for Sustainable Development in Kenya[64] and the 62nd International Astronautical Conference in South Africa.[65] Other IAA events on Africa comprise of the 62nd International Astronautical Congress themed African Astronaissance; Space for the African Citizen held in 2010 in Belgium[66] and the 3rd Africa–EU Summit of Heads of States held in 2010 in Libya. [67]

3.2 Africa's Relations with Global Space Powers

Several African states have managed to establish relations with some of the renowned global space powers as described below. The description of these relations depict Africa more as a recipient than a partner. African states receive expertise, funds/assets, technology and even management of the joint space projects with these global powers. This is a clear indication that policies on joint space activities are either inexistent or not implemented. In some instances, the donor space partners are the ones who have

[63] International Academy of Astronautics Conference, *Space for Africa: Path to Knowledge and Development*, (Abuja, Nigeria, 2007)
[64] The 4th African Leadership Conference on Space Science and Technology for Sustainable Development, (Nairobi, Kenya, 2011)
[65] The 62nd International Astronautical Conference, (Cape Town, South Africa, 2011)
[66] International Academy of Astronautics, *62nd International Astronautical Congress: African Astronaissance: Space for the African Citizen*, (Brussels, Belgium, 2010)
[67] International Academy of Astronautics, *The 3rd Africa–EU Summit of Heads of States*, (Tripoli, Libya, 2010)

facilitated drafting of the national space policies in their African partner countries. In as much as this goes a long way in Africa's development in space activities, it is also evident that such policies will be more aligned to meet the interests of the donors.

3.2.1 National Aeronautics and Space Administration (NASA)

NASA was established in October 1958. It is involved in several outer space activities among them studying climate change, cumulative changes in sea level, freshwater resources and severe weather events on the Earth, as well as analysing the mysteries behind the origin and development of the sun and wider solar system. NASA has agreements to support AERONET Sun photometer sites in 36 countries among them Kenya, Morocco, Mozambique, South Africa and Uganda from Africa. AERONET Sun photometer sites are independently operated in an additional 55 locations five of them being from Africa: Egypt, Mali, Mauritania, Mauritius, Niger, Nigeria, Papua New Guinea, Senegal, and Zambia. The AERONET sites in these locations, while not directly supported by NASA, are tied into the network and their data is openly shared.[68]

Students and educators from around the world including Africa partake in NASA education programs and take advantage of NASA education resources to enrich their understanding of science, technology, engineering, and mathematics (STEM) subject matter.

The Famine Early Warning System Network (FEWS-NET), operated by the U.S. Geological Survey (USGS), collaborates with international, regional, and national partners to provide timely and rigorous early warning and vulnerability information on emerging and evolving food security issues. Products from this system were used to help

[68] Steele Dylan, *Global Reach: A View of NASA's International Cooperation,* July 31, 2015, http://www.nasa.gov/connect/ebooks/global_reach.html

support the formal declaration of famine in Somalia by the United Nations and the U.S. Agency for International Development (USAID) in July 2011.

SERVIR is a joint program between NASA and the U.S. Agency for International Development (USAID) that provides satellite-based Earth observation data and science applications to help developing nations. This is through the SERVIR hubs consist of teams of scientific experts who translate satellite data into useful information for governments and non- governmental organizations in the host nations. In 2008, such a hub was opened in Nairobi, Kenya, serving the East and South African region and there is SERVIR West Africa program underway in Ghana.

Kenya hosts a UN Regional Centre for Mapping of Resources for Development (RCMRD) which utilizes data from American Earth observation satellites to respond to requests from member States for crop monitoring, water conditions, and disaster warning. The RCMRD also hosts the East Africa node of the SERVIR program mentioned above.

U.S. Strategic Command's Joint Space Operations Center (JSPOC) detects, tracks, and identifies space objects through an elaborate constellation of twenty-nine ground-based radars and optical sensors. In addition to protecting U.S. spacecraft, JSPOC extends this capability at no cost to the international community by warning countries and commercial space operators when their satellites are at risk from large space debris or other satellites.

3.2.2 Russian Federal Space Agency (Roscosmos)

Roscosmos is one of the partners in the International Space Station (ISS) programme and is actively engaged in the development of space vehicles, launchers and ground-based space infrastructure. Roscosmos was originally founded as the Russian

Aviation and Space Agency in February 1992. It is one of the two agencies inherited from the Soviet Space Programme run by the Soviet Union from the 1930s until its dissolution in 1991. Most of the satellites launched by African countries such as South Africa, Egypt, Nigeria, and Morocco among others have been with the assistance of Russia through its launch site in Kazakhstan. In 2006, Russia and South Africa signed an Agreement on cooperation in the field of the exploration and use of outer space for peaceful purposes. Angola plans on launching its first satellite, AngoSat-1, also being built by a Russian consortium into orbit by 2016.

3.2.3 European Union's Space Agency (ESA)

European Union's Space Agency was established in 1975. It is an intergovernmental organisation formed by ten founding member states. European Space Agency currently constitutes 22 member states. There is space cooperation between Africa and the EU particularly regarding observation of the Earth and satellite navigation. In addition to EU supporting space projects of independent African such as the Regional Earth Observation for Mediterranean Sea Emergency Surveillance (RAMSES) with Morocco to monitor oil spilling in the Mediterranean, the Union has laid emphasis in regional African space projects such as global monitoring for environment and security (GMES)-Africa initiative launched in December 2007, at the EU-Africa summit in Lisbon aimed at meeting the needs of African users in areas such as climate change, water resource management and food security. Other projects include the African-European geo-resources observation system (AEGOS) project and the extension of Europe's first satellite navigation system (EGNOS) to Africa. The 6th EU-Africa Space Troika meeting was held on 20 April 2015 in Brussels.

Another key collaboration between Africa and the EU on outer space activities is the EU-Africa Space Troika meeting. This is a forum that was set up in 2011 by the "College-to-College" meeting bringing together representatives of the African Union Commission Departments and European Commission Directorates involved in space matters so as to advance cooperation in space and monitor the implementation of agreed projects. The Troika is also aimed at enabling Africa to exploit its space resources and to coordinate synergies amongst space initiatives in the continent so that space systematically contributes to Africa's sustainable development efforts.

3.2.4 China National Space Administration (CNSA)

China has engaged Africa's regional institutions such as the African Union and its satellite sub regional organisations based on strategic partnerships thus challenging traditional parameters of EU African relations.[69] CNSA is one of the world-leading space agencies currently involved in the deployment of satellites for telecommunications and Earth observation, as well as space shuttles and launch vehicles.

The Chinese government adopted fundamental policies to develop their international space exchanges and cooperation. Since 2006, China has implemented international space exchanges and cooperation in various forms. It has signed a number of cooperation agreements and memoranda on the peaceful utilization of outer space with a host of countries including those in Africa, space agencies and international organizations. In 2007, China launched a Chinese-manufactured communications satellite into orbit on behalf of Nigeria. The geostationary satellite providing communications services over Africa and parts of the Middle East and southern Europe represented

[69]Uwe, Wissenbach, 'Africa's attractions – China, Africa and Europe', *The world today*, Vol LXIII, No. 4. (April 2007) pp. 7-9

China's wish to cooperate with developing countries in the peaceful use of outer space and to promote a closer relationship between China and African countries.

3.2.5 Indian Space Research Organization (ISRO)

Indian Space Research Organization is the first Asian space agency to reach Mars orbit. It is currently the world's first space agency to have achieved this in its first attempt in November 2013 when it launched the Mars Orbiter Mission (MOM), also known as Mangalyaan. ISRO currently operates one of the biggest fleets of communication and remote-sensing satellites. The organisation was formed as the successor to the Indian National Committee for Space Research (INCOSPAR) in August 1969. It has launched 75 spacecraft to date, and has been involved in 46 additional launch missions. ISRO designs and manufactures satellites, as well as providing commercial launch services. Through its cost-effective Polar Satellite Launch Vehicle (PSLV) developed in 1993, ISRO has successfully launched 51 foreign and 33 Indian satellites into space as of September 2015. Algeria for example which established its space agency in 2002, launched an earth observation satellite in 2010 from Chennai, India.

3.3 Non-State Space Actors in Africa

As early as 1963 Professors McDougal and Vlasic acknowledged that non-governmental entities, including private companies, have an important role to play in outer space.[70] Other scholars, like the late C. Wilfred Jenks and Professor Carl Christol,[71] also reiterated that both private and public use of outer space should take place for the benefit of all of mankind. Dr. Jenks actually indicated that governments need to

[70] Myres S. McDougal, Harold D. Lasswell & Ivan A., Law and Public Order in Space, (New Haven and London: Yale University Press, 19630 pp. 6-11

[71] Christol C. Q., 'The International Law of Outer Space', *Naval War College Newport, Rhode Island, International Law Studies 1962*, (Washington D.C. U.S. Government Printing Office, 1966) pp.84-88

encourage outer space activities such as launching of rockets or satellites by private enterprises.[72] In consistent with these authors on public-private partnership in outer space initiatives, the African continent has numerous examples of outer space initiatives by International organisations and private commercial companies.

More than 150 companies engaged in business related to Outer space activities such as the supply of geospatial products and services concerning or using Earth Observation (EO) data are registered in Africa. These are satellite operators, EO service providers and internal service departments inside companies engaged in different business like oil and gas, land use, environmental assessment among many others

Some of the identified Space activities in Africa initiated by International Organisations include:

Application of new methodology for estimating cultivated area, using radar data at the beginning of the cultivation season in Ethiopia, Sudan and Uganda through an initiative in the framework of the Global Monitoring for Food Security project of the European Space Agency in the area of food security in Africa through agricultural meteorology by WFP and FAO.

Support of the Regional Training Centre for Agro meteorology and Operational Hydrology (AGHRYMET), an institution of the Permanent Inter-State Committee for Drought Control in the Sahel (CILLS). This Institution supported by UNEP, UNDP, UNITAR, FAO, UNESCO and WMO works to increase agricultural production in the member countries of CILLS and to improve management of natural resources in the

[72] Jenks C., *The Common Law of Mankind*, (New York: Frederick A. Praeger, 1958) pp.382-407

Sahel region by, among other things, producing and disseminating information and providing training in the field of agricultural ecology.[73]

The "Africa Health Infoway" initiative, led by WHO in close partnership with ECA, ITU, and the African Union Commission that aims to strengthen health information management at the district level in Africa. The Infoway covers 53 African countries and is focused on district-level health data collection and processing and evidence-based decision-making in health. Satellite-based communication and long-distance wireless connectivity are among space-based applications planned for launch in the countries.[74] Other non-state space cooperation include the partnership between the International Astronomical Union (IAU) and the South Africa National Space Foundation to establish the Office of Astronomy for Development (OAD) that is aimed at raising funds for space research development projects in Africa.

3.4 Conclusion

Africa has been a consumer of space derived services provided by foreign states, multi-national companies and Inter-government organizations. These services crucial for the economic development of the African continent include Earth observation, satellite communication, navigation and positioning, space science and astronomy. This study observed that there is a significant technological divide between Africa and other regions in terms of capabilities to carry out activities in space. In this regard, the agreements that Africa as a continent or through its independent States has entered into with other state and non-state space actors has not been reciprocal because of funding and lack of

[73] http://www.cilss.bf
[74] http://www.who.int/africahealthinfoway/en

expertise. These and more other challenges established during the research are covered in the next chapter.

CHAPTER FOUR

CHALLENGES OF AFRICA'S INTERNATIONAL RELATIONS WITH OTHER SPACE ACTORS

4.0 Introduction

The development of outer space research, and other space related activities in Africa has led to an expansion of bilateral, regional and international programs of cooperation in those areas. This has led to the emergence of new challenging questions that call for attention. This chapter explores the challenges of Africa's International relations in outer space activities.

4.1 Challenges

This study established the following as challenges facing Africa's relations with other state and non-State space actors:

4.1.1 Financial Capability

The study identified that the cost of launching a satellite ranges from 50 to 100 Million US Dollars. In this regard, allocation of such an amount would favour cooperation initiatives dealing with the immediate needs in Africa such as education and food as compared to such expensive space related initiatives. This is the reason Africa is very poorly represented in the space science. Space technology is advancing at an increasing pace, yet most African countries lack the human, technical and financial resources to utilise existing space-based infrastructure for even the most basic applications in meteorology, communications and natural resource management.[75] Less than five countries in Africa own micro satellites, moreover, this is still through external assistance from other developed nations.

[75] NEPAD, 2006:45

In 2011, the Russian government spent about $3.8 billion for their space programmes while their proposed budget for the year 2013 was $5.6 billion. Unites States of America spends about $8.3 billion a year on Space missions.[76] The budget allocated for space programmes in African States generally remains a guarded secret and the information available is mostly on the budget allocated for science and technology departments where space programmes falls under. In this regard, establishing how much specifically is spent on space programmes is therefore a challenge.

However it is evident that in comparison to other space actors in relation to space object launches, Africa is still way behind. For example out of the total number of 7,370 space objects recorded to have been launched into space globally as at 2015, only 17 were launched by African States. The table below indicated this.

Table 4.1: UNOOSA Online Index of Objects Launched into Outer Space

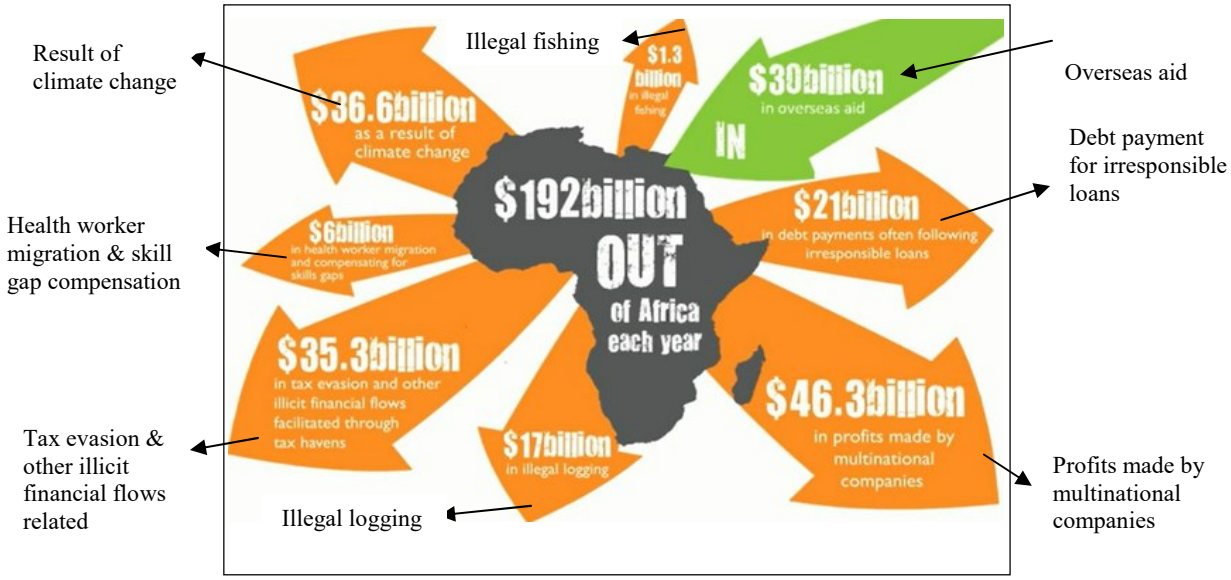
Space actors	**Number of Space objects launched**
Russia	3485
USA	2431
China	312
India	78
EU	87
Africa	17
Others	960
Total	7,370

African States rely on external international aid to fund most of their projects especially space projects in the belief that it is impossible to fund these projects by themselves. This poses a challenge of funding joint space initiatives that would be key to the continent's economic liberation without having to adhere to unfavourable conditions that many a times exist in relation to these externally funded space initiatives. Owning

[76] Lafleur Claude, *Costs of US piloted programs*, Space Review in association with Space news, March 8, 2010, http://www.thespacereview.com/article/1579/1

their own satellites will also enable African governments to operate more independently and effectively. According to a report released by poverty Action group, a coalition of UK and African NGOs in July 2014,[77] sub-Saharan Africa receives $134bn each year in loans, foreign investment and development aid, however $192bn leaves the region, leaving a $58bn shortfall. The report illustrated that Africa is purported to be a recipient of aid while in reality, it aids the world. The report further pointed out that foreign multinational companies siphon $46bn out of sub-Saharan Africa each year, while $35bn is moved from Africa into tax havens around the world annually. On the other hand, donors who lend money to Africa dictate what the money should be used for.

Fig. 4.1: Heath poverty action group's report on International aid in Africa



[77] http://www.healthpovertyaction.org/wp-content/uploads/downloads/2014/07/Honest-Accounts-report-v4-web.pdf
The report was authored by 13 UK and Africa-based NGOs, including: Health Poverty Action, Jubilee Debt Campaign, World Development Movement, African Forum and Network on Debt and Development, Friends of the Earth Africa, Tax Justice Network, People's Health Movement Kenya, Zimbabwe and UK, War on Want, Community Working Group on Health Zimbabwe, Medact, Healthworkers4All, Friends of the Earth South Africa, JA!Justiça Ambiental/Friends of the Earth Mozambique.

4.1.2 Policy

Space activities have been of marginal political interest in Africa, thus leading the continent to be the late starter in space matters. Africa is the least active continent with regards to space activities.[78] There is also lack of efficient laid out mechanisms of monitoring and evaluation at national and regional level especially in regards to the implementation of an African space programme. This has led to establishment of initiatives that are not well tailor made for the continent. Internationally, the world lacks a feasible plan for monitoring compliance or sanctioning prohibited behavior in relation to outer space activities.

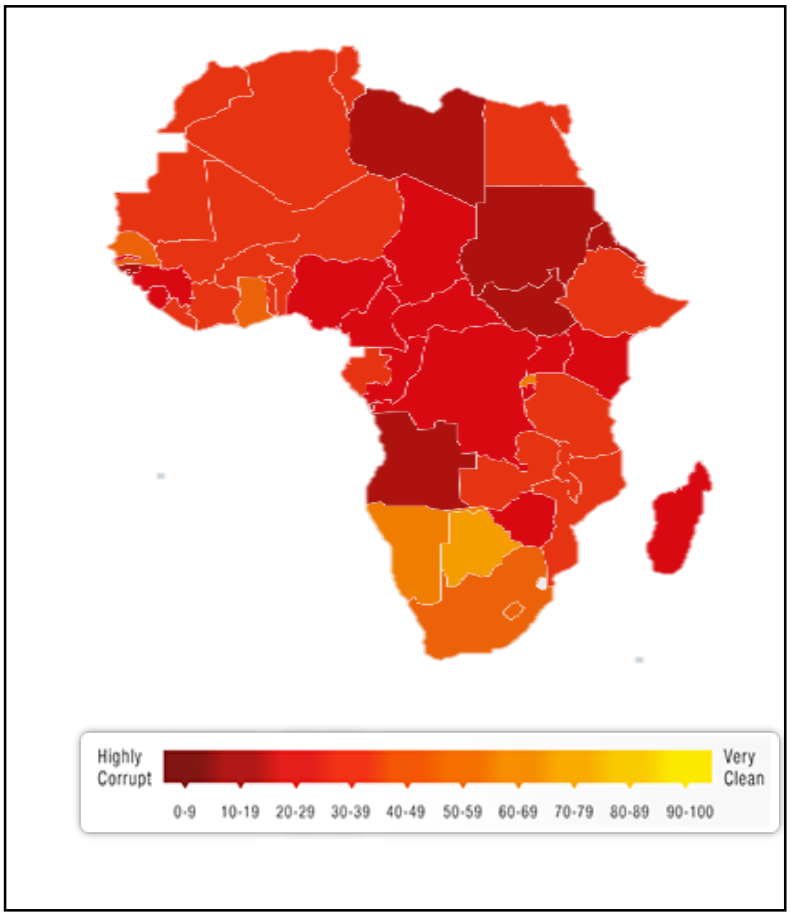
An analysis of the African space policy reveals that one of the goals for the African continent is to use space science and technology to improve the quality of life of the African people and to be able to also generate wealth. Another goal is to form a local space industry that is for Africa by Africa so as to meet the needs of the local market. Since only a few countries in Africa have already established capacities to engage in space programmes, those are the countries that are expected to play a bigger role in the continent's space policy implementation. This poses a challenge of domination of the other countries without any such programmes by those who are slightly ahead in relation to space capacity.

To be able to set up a joint space agency for the continent, there has to be proper management and good governance of such an initiative. The independent States have not shown a very good report in relation to managing their national public resources as shown in the transparency international's corruption index map of 2015 below.[79] There is

[78] Sharpe C. Space economic readiness – Economic analysis of public funding of space technology in developing African countries [dissertation]. Strasbourg: International Space University; 2010.
[79] http://www.transparency.org/cpi2015

therefore a challenge of bad governance that automatically translate to implementation and running of joint initiatives such as space programmes. The map is a clear indication that Africa is composed of highly corrupt countries in the world.

Fig. 4.2: Transparency International's corruption perception index map of 2015



The map was a result of expert opinion that measure the perceived levels of public sector corruption worldwide. The African map was extracted from the global map for its relevance to this study. Countries in dark red ink indicates those found to have highly corrupt public sector. Lighter red and orange countries had slightly less corruption and yellow countries were perceived to be clean but not perfect.

Another factor that affect space policy making or space policy implementation in the African continent jointly or independently is the issue of conflicts. According to the annual Fragile States Index report for 2014 by Fund for Peace, 15 out of top twenty "Most Failed States on Earth" are from Africa.[80] The indicators used to come up with this findings were mostly related to security and conflict related aspects.

Table 4.2 Status of African States from the Fund for Peace annual Fragile States Index report of 2014

Status	**Countries and their rank**	**Indicators used**
Very High Alert	All top five were African States. These were South Sudan, Somalia, Central African Republic, Congo (D. R.), Sudan.	Demographic pressure Refugees & IDP's Group grievance Human Flight Uneven Economic Development Economic decline State Legitimacy Public services Human Rights & the Rule of law Security Apparatus Factionalized elites External intervention
High Alert	5 out of 11 were African States. These were Chad, Zimbabwe, Guinea Cote d'Ivoire, Guinea Bissau	
Alert	11 out of 19 were African states. These include Nigeria, Kenya and Ethiopia	
Very high warning	18 out of 27 were African states	
High warning	9 out of 43 were African states	

The table above indicates that Africa did not feature in the Very stable, Sustainable and Very sustainable categories which consist of states from other regions. It is therefore very unlikely that any major policies by African countries or by the development partners will prioritise space initiatives to for example conflict management given the above conflict ratings.

[80] http://fsi.fundforpeace.org/rankings-2014

Other challenges identified to be facing Africa's international relations in relation to space policy are the changes in the geo-economic and political conditions that occur in Africa during the implementation of space projects that many times need long term commitment of up to or over ten years, contradicting national policies in relation to data and intellectual property rights and the complication related to enhancing international cooperation when there is also a need to protect the competition of national space industrial base.

4.1.3 Capacity Building

Africa does not have the capacity to develop its own space technology services and products. Almost all of the space resources in African States are not owned by African States let alone managed by them. The study established that more advanced space state actors may enter into cooperative activities with emerging space nations such as those in Africa as a way of building alliances, or developing new markets for their space industries. In these types of cooperation, the space powers normally assume responsibility for the more challenging innovative aspects of the mission, since in case the cooperation fails for whatever reason, they can proceed on their own.

Regional integration constitutes a potential vehicle for the diffusion of better policy practices across African countries. It might be necessary for benchmarking of the links between science and industry in different African countries. This will lead to a better understanding of the main barriers affecting the role of science in innovation as well as improved policies in countries. To achieve the tenets of the AU Agenda 2063, African countries should increase their efforts in improving measures towards scientific advances and technological progress, to spur economic growth and social change.

The study identified that Africa's space relations with other space actors are faced with the challenges in the building of an Africa-based workforce. The curriculum of most African schools has no substantive courses on space studies. In this regard, Africa still continues to depend on outsiders to implement programmes instead of enhancing its own people's capacities in this area. An all-inclusive strategy incorporating these studies from pre-primary all the way to post-secondary education is also lacking. These include: developing professional teachers to teach this, seeking opportunities of including space content in higher learning institutions such as universities and colleges, identifying international space research programs that may absorb students and improving the ICT infrastructure to ensure the African people have access of up to standard technologies. An example of the very few such capacity building collaboration in Africa identified is the African Regional Center for Space Science and Technology Education in English (ARCSST-E) program in Nigeria that has collaborated with UN-COPUOS for 10 years to nurture space related education through working with teachers.

Africa depends on new space technologies even though it lacks enough capital and any efforts to support establishment of the continent's infrastructure to support its own satellite system have not yet borne any fruit. This leads to the continent being vulnerable to developed space actors economic and political power hence the inability to maintain sovereignty economically, politically and even culturally.

4.1.4 Information Sharing

United Nations, through the Committee on the Peaceful Uses of Outer Space (COPUOS) and the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER) continue to play a pivotal role in

ensuring that countries share the benefits of space activities with others. There is still need to enhance capacity-building for developing countries to exploit available data through space technology especially to better prepare for future catastrophes. Also, transparency is not universally practiced by space powers who in certain cases are reluctant to publicly announce some of their activities which involve spying. An example is the revelation that the Satellite Sentinel Project (SSP) co-founded by Actor George Clooney in 2010 was for monitoring the military activities of President al-Bashir of the Republic of the Sudan.

Another aspect of the challenge facing Africa's international relations with other space actors is that of Transnational Data Flows and also the use of Direct Broadcast Satellites, with the ability to by-pass ground stations belonging to countries. These raises questions concerning the issues of sovereignty and privacy in relation to freedom of information that can be accessed specifically what kinds of information are flowing in and out of the country, to whom, and for what purpose. In addition to the fact that a nation's ground stations can be by-passed raises questions as to how these countries maintain their cultural integrity.

The other issue is the powerful centralizing and decentralizing effects that transnational data flows offer to multinational companies in relation to information, natural resources, employment and intellectual property. These services allow multinational corporations to control a lot of information from a central point and also at the same time allow them to devolve or disseminate the same to any nation of their choice such as in relation to employment or unemployment An example is the online jobs

like typing digitally sent from developed nations to Africa for less pay than it actually costs in those countries.

There is also lack of consistency in methods of data collection, the kind and quality of data collected and used by the various institutions, networks and projects involved in space technologies. This lack of standardisation of data leads to problems in data sharing at the various levels.

4.1.5 Competition over Collaboration

An African space race is already under way. Several African countries have satellites in the earth's orbit while there are others with similar projects underway. However, even if African resources and skills were to be combined, an operational African Space Agency would still take many years to be operational. This joint project would also undoubtedly depend upon political relations between major space powers in the continent such as Nigeria and South Africa, which has not been very rosy. The two countries have been in competition for the role of first regional space power within a geopolitical area affected by conflicts and comprised of several weak and failed states. Many African countries are therefore focused on growing their own space agencies first.

Another factor is the coinciding geopolitical-geoeconomic game in Africa among global powers like United States of America and China and their race to cooperate and invest in space programmes with emerging space actors in the continent. It is therefore highly unlikely that African countries cooperate with one another and at the same time with global space actors politically and commercially opposed to one another. However it is necessary that African States place their national interests first like in the example of Nigeria and South Africa where Nigerian satellites built by British enterprises were

launched by Chinese space rockets and South African Space Agency cooperates with the NASA Mars Curiosity mission, but its satellites put into orbit with Russian launch vehicles.

4.1.6 Apathy for Outer Space Activities

Most African people and even foreigners have questioned why African countries that receive foreign aid are investing in expensive space initiatives. This is because Space programmes are not part of traditional development models like agricultural projects that are overemphasized over space technology. Also because of ignorance on the benefits of space programmes and those of cooperation in such projects, many political leaders in Africa prefer to initiate short term and visible projects that have an immediate direct impact on their people's lives. In this regard, leaders who may propose to invest in space projects that may take a longer time to bring in returns may not be so popular with the people.

There is therefore a need to increase awareness within all African countries of the beneficial applications of space techniques. This study's aim was also promoting public interest in outer space relation in Africa and hopefully will be an eye opener in gauging whether some of the agreements and treaties on outer space that Africa is party to provide an adequate framework to address the continent's challenges.

4.2 Conclusion

Despite the challenges identified above, there is a bright future for development of outer space activities in Africa. Most of the challenges African states are currently facing can be prevented if there was a collective bargaining power of African States seeking information accessed through outer space technology by other developed space

actors for example on effects of climate change, famine and poor urban planning among others. This study determined that cooperation of African states in outer space initiatives is inevitable. Therefore, there is a need to create awareness on the issues and benefits of positive cooperation in this field. .

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter provides conclusions of the study, gives recommendations and suggests areas for further study.

5.1 Summary of Findings

Findings from this study can be summarised as follows:

5.1.1 Cooperation on African States on issues of Outer space

There is low level of participation of African states in outer space programmes hence a consolidated African position that best serves the African people has not been perceived when international agreements on outer space are considered for implementation. As indicated in table 5, in the previous chapter, this research indicated that out of the 7,370 space launched into space objects globally, only 17 are by African states. The following table gives a breakdown of these space objects launched by African States.

Table 5.1: Number of Space objects launched by African states extracted from UNOOSA website by the researcher

Country	No of Space objects launched	Launch site
South Africa	4	1 from Vandenberg Air Force Base in the USA 3 from Boikonur, Kazakhstan leased by Russia up to 2050
Nigeria	4	3 from Boikonur, Kazakhstan leased by Russia up to 2050 1 from Xichang, China
Morocco	1	Boikonur in Kazakhstan and leased by Russia up to 2050
Egypt	5	3 from Kourou, French Guiana, France 2 from Boikonur, Kazakhstan and leased by Russia up to 2050
Algeria	2	1 from Sriharikota, India 1 from Plesetsk Cosmodrome, Russia
Mauritius	1	Kourou, France

From the table, it is clear that African States have not been in a position to enter into partnerships or agreement to launch space objects on behalf of or for each other. There is no space object that has been launched by an African State with the help of another African State.

Current space activities by the various space actors in Africa are totally uncoordinated. There is therefore need for effective coordination structures at a continental and also at regional levels to ensure there is proper implementation and harmonisation of the various space activities operational in Africa.

5.1.2 Africa's Relations with Other State and Non-State Space Actors

International organisations have been the key supporters of outer space initiatives in Africa particularly geared towards poverty alleviation programmes in sectors such as agriculture. There has also not been any study carried out to compile or record the nature of operation, opportunities, threats and challenges that private commercial companies that engage in space related activities encounter or the effects of their operation on the African people.

Also from table 5, the research establishes that partnership between Africa and other space actors is not sustainable for Africa. This is because the space objects launched by African States were launched from abroad yet Africa has space launch sites that have only launched objects for other external partners. Launching the objects from Africa would enhance development of the region through development of the infrastructure needed for launching, technological transfer and spillover effects of the growth of smaller industries directly or indirectly related to the sector such as security firms, insurance, fuel companies among others.

5.1.3 Key Challenges of Africa's International Relations on outer space

This study established that other African challenges to implementation of space based management include among other things, poor record keeping in disaster management, lack of timely access to space derived data, dependence on other countries for data access, lack of know how in developing products useful to responders on the ground. Lack of funding and cooperation and coordination among African countries with global organisations for the distribution of space derived information is also another key challenge.

There is also need for international regulatory institutions such as UNOOSA to have power and authority to implement programs that would first develop a code of ethics for the transfer of technology and intellectual property to African states, encourage collaboration between Africa and multinational corporations on program development on independent satellite use and remote sensing, encourage provision of incentives to multinational corporations to develop suitable technologies like through using the money collected from the rent/tax on space activities and provide funding for space development projects that uplift living standards and basic capabilities of African people. This would enhance steady and equitable growth of the global economy into outer space.

5.2 Conclusions

Conclusions from this research are indicated as follows:

5.2.1 Cooperation of African States on Issues of Outer Space

There is minimal engagement of African countries in space related activities compared to other regions globally. The current space asset base in Africa is limited and also with competition. Cooperation can increase the effectiveness of national programmes by minimizing duplication, pooling resources for large projects, supporting

foreign policy objectives, strengthening the bonds of alliance and friendship and bolstering national prestige.

5.2.2 Conclusion on Africa's Relations with Other State and Non-State Space Actors

Space exploration has many benefits for Africa's international business realm. First of all, space exploration projects require large amounts of human capital, technology, and resources. Due to the sheer size and scope of these projects, international collaboration is often a necessity for success. This was exactly the case for the International Space Station where multiple countries joined together to successfully create a livable space station allowing the longest continuous human presence in space. Space projects like these foster strong and cooperative international relations among countries around the world. Healthy international relations as a result of these collaborative space projects can create a strong foundation for international trade and trade agreements. It is also crucial that African States come up with an African position that can be heard and that serves an African space programme.

5.2.3 Key Challenges of Africa's International Relations in Outer Space

Establishment of a regional structure for cooperation, such as an African space agency, will only be a reality when a number of nations on the continent will commit considerable budgetary and other resources to the development, construction and operation of space systems. In the meantime, other initiatives that build capacity through networks of regional institutions should be supported. One such initiative is the proposal in the NEPAD/AU Africa Consolidated Science and Technology Plan to establish an African Institute of Space Science as a networked organization. This will build on

existing capacity in African institutions and provide a springboard for countries to develop their own capacity in areas of interest to them.

Indeed, a pan-African agency would be beneficial but only if the individual national agencies were each to be strong contributors and reliable. While exchange and coordination of information and resources would be beneficial, there is no point in incurring extra cost and bureaucracy if the national expertise is not there to be exploited

It is necessary for Africa to participate in and coordinate its space activities. Moreover, it is also important for developed countries to show their commitment in assisting Africa both financially and in knowledge transfer for success of Africa's regional space programmes. To be able to resolve some of the international conflicts surrounding commercial space activities and the equitable distribution of outer space resources, we need to reexamine the conflicting rights claims and ethical perceptions employed by Africa and also those by the developed space state.

5.3 Recommendations

The following are recommendations from this research:

5.3.1 Cooperation on African States on Issues of Outer space

This study recommends that African States adopt and implement data sharing procedures to ensure equitable access to data acceptable to all member States. This will ensure that States that have space assets share data services and products with States without such capacities.

To develop and increase Africa's space asset base, there is need to minimize duplication and enhance more complementarity through collaboration rather than competition and

also utilizing the competencies of the national space programmes already in existence in the continent.

5.3.2 Africa's Relations with Other State and Non-State Space Actors

This study recommends that for the African continent to achieve any meaningful return from cooperation with other space actors in any space related activities, the partnerships should be based on a fair and mutually beneficial approach that ensure favourable socio-economic returns to the African States. There is need to pursue public-private partnerships based on complimentary capabilities, through effective technology transfer and intellectual property management arrangements

. These partnerships should also consider focusing on the development of space services and products in response to regional and export market.

5.3.3 Key challenges of Africa's International Relations in Outer Space

African states need to focus on developing a sustainable and vibrant indigenous space industry that promotes and responds to the needs of the African continent. This is through using the space resources vested in a few African states to provide technological know-how and knowledge transfer on data and information dissemination and operational services and products to non-space nations in Africa in order to leverage the full socio-economic benefits.

African Space technology services and products have to be developed through African capacity so as to ensure sustained ownership of the space resources managed by African States. One way would be through adopting learning programmes to build the continent's capacity and maintain widespread use of space application within the continent.

Africa needs to adopt key performance indicators for regular reviews of its space products and services to ensure that the capacity building initiatives and methodologies as well as the user needs are up to date.

In regards to financial implication for space related activities in the continent, this study recommends that African States use existing space infrastructure through joint research and development initiatives. This will be cheaper and also enhance technical development, technology transfer, management of intellectual property rights as well as strengthen the capacity of the African States themselves. There is also need to encourage African States to invest in regional and sub regional centers to cater for interests of all regions to eventually link up the continent. In addition, the main source of funding for joint space activities in Africa should be from the African governments themselves to preserve independence of the initiatives.

Other recommendations include:

- African States should take advantage of the ICT Revolution, specifically with reference to distance learning opportunities.
- African States should develop opportunities for networking amongst themselves
- African States should participate actively in International conferences where space law issues are considered.
- African partnerships in Space laws, including between practitioners, academic and policy makers should be built and strengthened.

BIBLIOGRAPHY

Abiodun A.A., 'Future trends in the global arena: Challenges and opportunities for Africa' *African Skies/CieuxAfricains*, Vol XII, (2008) pp.12–22.

AfricaSTI, *African Union launches Pan-African University,* Africa Science Technology & Innovation News, Dec 21, 2011, http://www.africasti.com/lead-stories/african-union-launches-pan-African-university

AJ Lewis, *Space Exploration in a changing International Environment*, (Center for Strategic and International Studies, 2014)

Akinyede, J O, & G I Agbaje. 'Remote Sensing: From Pixels to Processes', *Proceedings from ISPRS*, VOL XXXVI, (Enschede, Netherlands, 2006)

Al-Rodhan Nayef R.F, *Meta-Geopolitics of Outer Space: An Analysis of Space Power, Security and Governanc*e, (St Antony's. Palgrave: Macmillan, 2012) pp.3

Augustine A.A., *Africa considers a continent-wide space agency. Science and Development Network*, http://www.scidev.net/en/news/africa-considers-acontinent- wide-space-agency.html, 20th August 2010 and 18th June 2012

Bolt Paul J., Coletta Damon V. Coletta & Shackelford Collins G., *American Defense Policy: American Defense Policy Series*. (JHU Press, 2005) pp.382-384

Boroffice R A. 'the Nigerian Space Programme: An Update', *African Skies*, No. 12 (2008) pp. 40- 45

Brunner Christian & Soucek Alexander, *Outer Space in Society, Politics and Laws,* (2012) pp.173

Cadbury Deborah, *Space Race*, (Harper Perennial, Reprint edition, 2007)

Christol C. Q., 'The International Law of Outer Space', *Naval War College Newport, Rhode Island, International Law Studies 1962*, (Washington D.C. U.S. Government Printing Office, 1966) pp.84-88

Dickson, P., *Sputnik: The Shock of the Century*, (New York: Walker Publishing Company, Inc. 2001)

Feagin, J., Orum, A., & Sjoberg, G., *A case for case study*, (Chapel Hill, NC: University of North Carolina Press 1991)

Foster Jr. J. S., et al, 'Report of the commission to assess the threat to the United States from electromagnetic pulse (EMP) attack', *Executive Report*, Vol. I, (2004)

Glaser Charles L., 'Realists as Optimists: Cooperation as Self-Help', *International Security* Vol XIX, No.3 (Winter 1994/1995), pp.50–90

Gottschalk K, 'South Africa's space programme – Past, present, future', *Astropolitics*, Vol VIII, No. 1, (2010) pp. 35-48, http://dx.doi.org/10.1080/14777622.2010.496528

Hans Morgenthau, *Politics among Nations: The Struggle for Power and Peace* (New York: Alfred A. Knopf, 1960)

Harman, S. & Brown, W., *In from the margins? The changing place of Africa in International Relations*, (International Affairs, 2013) pp.69–87

H.E. John F. Kennedy, *America's Space Effort*, (address at Rice University, Houston, Texas, September 12, 1962)

H.E. President Barack Obama, *Speech on Space exploration in the 21st Century, John F. Kennedy Space Center*, Merritt Island, Florida, 15 April 2010, 2:55P.M.

Hogan Thor, *National Aeronautics and Space Administration, Mars Wars: The Rise and fall of the Space Exploration Initiative*, (Government Printing Office, 2009)

*International Conference on New Challenges in Space Law. The Space Treaties at Crossroads: Considerations for de legeferenda, (*28 - 29 August, 2015, Athens)

International Academy of Astronautics Conference, *Space for Africa: Path to Knowledge and Development*, (Abuja, Nigeria, 2007)

International Academy of Astronautics, *62nd International Astronautical Congress: African Astronaissance: Space for the African Citizen*, (Brussels, Belgium, 2010)

International Academy of Astronautics, *The 3rd Africa–EU Summit of Heads of States*, (Tripoli, Libya, 2010)

Jenks C., *The Common Law of Mankind*, (New York: Frederick A. Praeger, 1958) pp.382-407

John F. Kennedy, *America's Space Effort*, (address at Rice University, Houston, Texas, September 12, 1962)

Kissinger Henry, *Diplomacy*, (Simon & Schuster; Reprint edition 1995)

Lafferranderie Gabriel & Crowther Daphné, *Outlook on Space Law over the Next 30 Years: Essays Published for the 30th Anniversary of the Outer Space Treaty*, (Martinus Nijhoff Publishers, 1997) pp. 290

Lambakis Steven, *On the Edge of Earth: The Future of American Space Power*, (Kentucky: University Press of Kentucky, 2001)

Lambakis Steven, *On the Edge of Earth: The Future of American Space Power*, (University Press of Kentucky. 2001) pp.39-71

Lewis James Andrew, 'Space Exploration in a changing International environment', *A report of the Center for Strategic & International Studies, (CSIS),* (July 2014) pp.5

Mahan, A. T., *The Influence of Sea Power upon History*, (Digital Antiquaria, Incorporated, 2004)

Maluwa Tiyanjana, *International Law in Post-Colonial Africa. Volume 4 of Studies and Materials on the Settlement of International Disputes*, (Martinus Nijhoff Publishers, 1999)

Manzione, Lara L. 'Multinational Investment in the Space Station: An Outer Space Model for International Cooperation?' *American University International Law Review*, Vol 18, No. II (2002) pp.507-535

Martinez, Peter, 'The African Leadership Conference on Space Science and Technology for Sustainable Development', *Space Policy*, Vol XXVIII, No. 1, (2012) pp. 33-37

Mckinell L., *Space Science Research in Africa*, (SANSA, 2013), http://www.bc.edu/content/dam/files/sites/amisr/presentations/F0900_McKinnell_AMSIR-workshop-Boston.pdf

Moore John A. & Pubantz Jerry, *The New United Nations: International Organization in the Twenty-First Century*, (Routledge, 2015)

Muchie Mammo, Gammeltoft Peter & Lundvall B. A., 'Putting Africa First', *The making of African innovation systems* (2003).

Mugenda O.M. & Mugenda A.G., *Research Methods Quantitative and qualitative approaches*, (Nairobi: Acts Press, 2003)

Myres S. McDougal, Harold D. Lasswell & Ivan A., *Law and Public Order in Space*, (New Haven and London: Yale University Press, 19630 pp. 6-11

Neil Morris, *What Does Space Exploration Do for Us? Earth, Space, and Beyond,* (Raintree, 2012) pp.28

Ngcofe Luncedo & Gottschalk Keith. 'The growth of space science in African countries for Earth observation in the 21st century', *South African Journal of Science*, Vol CIX, No.1/2 (2013) pp.1-5

Pelton Joseph N., Oslund Robert J. & Marshall Peter, *Communications Satellites: Global Change Agents,* (LEA Telecommunications Series. Routledge, 2004) pp.102

Rembe, Nasila S., 'Africa and the International Law of the Sea: A Study of the Contribution of the African States to the Third United Nations Conference on the Law of the Sea', *Series on Ocean Development*, Vol. VI, No. 5, (BRILL, 1980)

Roberts Darryl. 'Space and International Relations', *The Journal of Politics*, Vol L, No. 4 (1988) pp.90, http://www.jstor.org/stable/2131393.

Rose, Gideon, 'Neoclassical Realism and Theories of Foreign Policy', *World Politics*, Vol. LI (October 1998), pp.144-172

Sabathier Vincent G. & Faith G. Ryan, 'The Global Impact of the Chinese Space Program', World *Politics Review*, (May 17, 2011)

Sheehan Michael J., *The International Politics of Space: Space power and politics*, (Routledge, 2007)

Smith David, *African correspondent, Sudanese president calls for African space agency*, September 6, 2012, https://www.theguardian.com/world/2012/sep/06/sudanese-president-african-space-agency

Space Foundation, 'Space Applications for International Development', *The Space Report*, (Colorado Springs: 2009)

Steele Dylan, *Global Reach: A View of NASA's International Cooperation*, July 31, 2015, http://www.nasa.gov/connect/ebooks/global_reach.html

The 4th African Leadership Conference on Space Science and Technology for Sustainable Development, (Nairobi, Kenya, 2011)

United Nations, *Space Benefits for Africa: U.N. Doc. IAM/2009/CRP.7* (United Nations Inter-Agency Meeting on Outer Space Activities, Twenty-ninth session, 4-6 March 2009, Vienna)

Uwe, Wissenbach, 'Africa's attractions – China, Africa and Europe', *the world today*, Vol LXIII, No. 4. (April 2007) pp. 7-9

Waltz Kenneth M., *Theory of International Politics*, (Reading, MA: Addison-Wesley, 1979) pp. 17-27

Weeks Edythe, *Outer Space Development: International Relations and Space Law: A Method for Elucidating Seeds* (Newcastle upon Tyne, U.K.: Cambridge Scholars Publishing, 2012)

Yin, Robert K., *Case Study Research: Design and Methods, 3rd edition* (Thousand Oaks, CA: Sage Publications, 2003)

Zakaria Fareed, 'Realism and Domestic Politics', *International Security*, Vol XVII, No. 1 (Summer 1997), pp.162–183

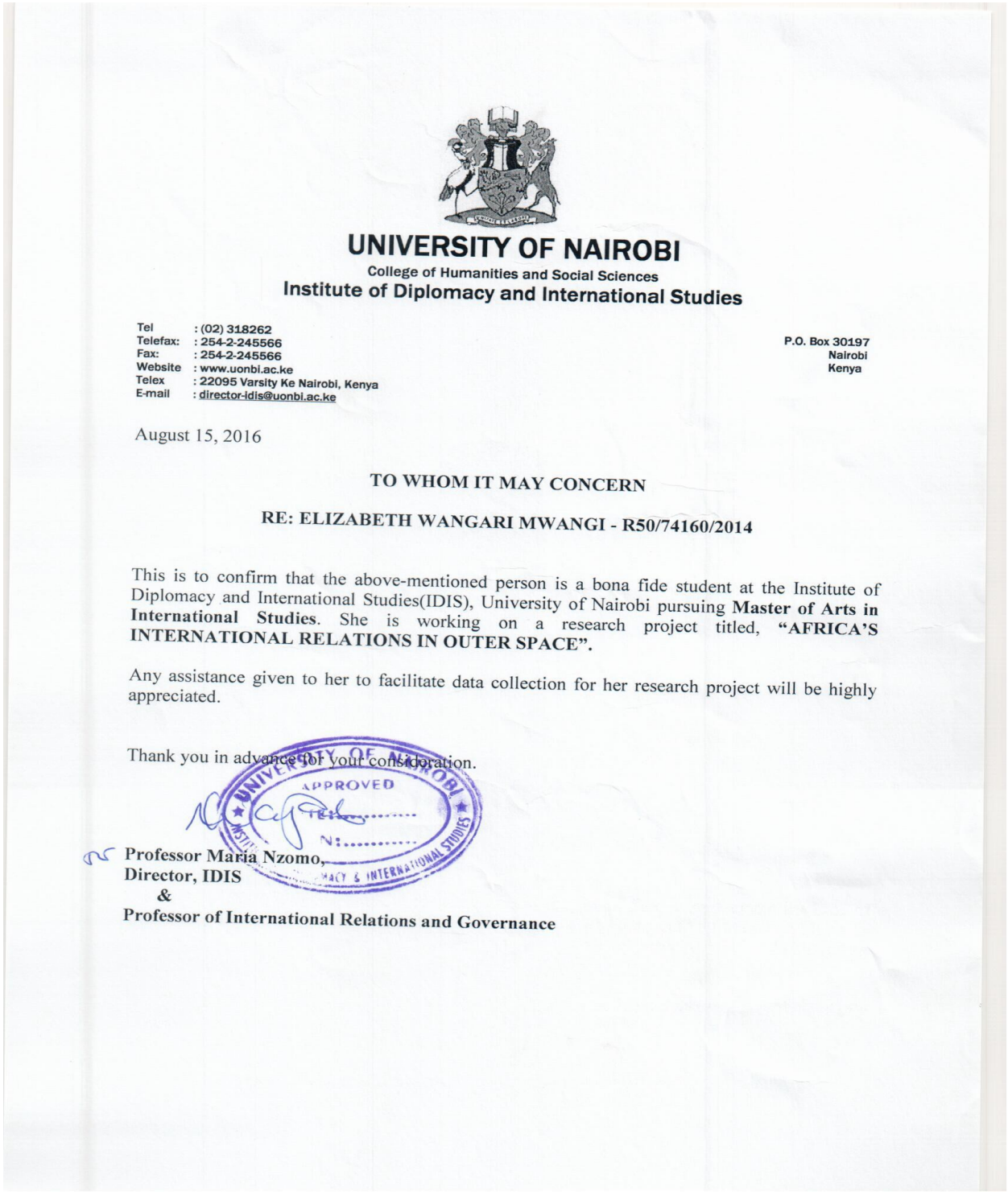
http://fsi.fundforpeace.org/rankings-2014

http://www.transparency.org/cpi2015

http://www.healthpovertyaction.org/wp-content/uploads/downloads/2014/07/Honest-Accounts-report-v4-web.pdf

APPENDICES

Appendix I: Letter of Authority



UNIVERSITY OF NAIROBI
College of Humanities and Social Sciences
Institute of Diplomacy and International Studies

Tel : (02) 318262
Telefax: : 254-2-245566
Fax: : 254-2-245566
Website : www.uonbi.ac.ke
Telex : 22095 Varsity Ke Nairobi, Kenya
E-mail : director-idis@uonbi.ac.ke

P.O. Box 30197
Nairobi
Kenya

August 15, 2016

TO WHOM IT MAY CONCERN

RE: ELIZABETH WANGARI MWANGI - R50/74160/2014

This is to confirm that the above-mentioned person is a bona fide student at the Institute of Diplomacy and International Studies(IDIS), University of Nairobi pursuing **Master of Arts in International Studies**. She is working on a research project titled, **"AFRICA'S INTERNATIONAL RELATIONS IN OUTER SPACE".**

Any assistance given to her to facilitate data collection for her research project will be highly appreciated.

Thank you in advance for your consideration.

UNIVERSITY OF NAIROBI APPROVED Tel..... P.O. Box..... INSTITUTE OF DIPLOMACY & INTERNATIONAL STUDIES

Professor Maria Nzomo,
Director, IDIS
&
Professor of International Relations and Governance

Appendix II: Letter of Introduction

To whom it may concern,

RE: KIND REQUEST FOR PARTICIPATION IN MY ACADEMIC RESEARCH

My name is Mwangi Elizabeth Wangari. I am a student at the University of Nairobi undertaking a Master's degree at the university's Institute of Diplomacy and International Studies. I am currently conducting a research on International Relations of Africa in Outer Space. In this regard, I kindly request that you to take part in the research as part of the requirements for the award of the degree.

You are welcome to participate.

Thank you.

Elizabeth Wangari Mwangi

Appendix III: Consent Cover Letter

Dear Participant,

You are invited to participate in this research study entitled International Relations of Africa in Outer Space. The researcher is currently enrolled at the Institute of Diplomacy and International Studies at the University of Nairobi and in the process of writing her Master's Thesis.

The purpose of the research is to explore Africa's relations in enhancing its global standing in the Outer space frontier. The enclosed questionnaire has been designed to collect information on intra African cooperation in outer space, the extent and scope of Africa's relations with other state and non-state space actors and to identify the challenges Africa faces in its International Relations in regards to outer space exploration.

Your participation in this research project is completely voluntary. You may decline or leave blank any questions you do not wish to answer. There are no known risks to participation beyond those encountered in everyday life. Your responses will remain confidential and anonymous. Data from this research will only be reported only as a collective combination of the findings.

If you agree to participate in this project, it should take approximately 20 minutes to complete. If you have any questions about this project, feel free to contact the researcher on, Tel: 0725672287 or, e-mail: lizwangari2001@yahoo.com and P.O. Box 55461-00200 Nairobi.

Your signature indicates that you have read and understood the information provided above, that you willingly agree to participate, that you may withdraw your consent at any time and discontinue participation without penalty.

Thank you for your assistance in this important endeavor.

Signature_____ Date_____

Appendix IV: Questionnaire Administered to Key Informants from African States

(Please tick where necessary)

1. Name of the country you represent _____
2. Is your country involved in any outer space activities? Yes □ No □
3. Does your country have any laid out policies and regulations related to cooperating with other State and non-state space actors? Yes □ No □
4. Is there any government funding towards supporting outer space activities? Yes □ No □
5. What percentage of your country's economic budget is dedicated to Outer space activities

   a) At a national level_____

   b) In cooperation with other African States _____
6. Has your country launched any space objects? Yes □ No □

   If yes, how many? _____
7. Is your country a launch site of any foreign country's space objects? Yes□ No □

   If yes, please provide the names? _____
8. Which African States has your country signed bilateral agreements with_____

   _____
9. Which multilateral agreements related to Outer space activities is your country party to

   a) In Africa _____

   _____

b) Outside Africa _____

_____

_____

10. Do you think African countries are collaborating more with each other on Outer Space activities? a) Yes □ No □

    b) If no why do you think so?

    _____

    _____

11. Is there readily available data in your country on Outer Space initiatives in Africa?

    Yes □ No □

12. Are agreements on outer space that your country is party to confidential or open to the public _____

13. On a scale of 1-10, how would you say Outer space cooperation is important to your country? (10 being the highest importance/cooperation) _____

14. Does your country have a functional National Space programme? Yes □ No □

15. What are some of the challenges you can identify that African States face in their International relations in outer space activities?

    _____

    _____

    _____

    _____

    _____

    _____

b) What are some of the solutions you would recommend concerning the challenges you identified above?

_____

_____

_____

_____

_____

16. Are there any higher education training institutions that offer Outer Space related courses in your country? Yes □ No □
17. Which International Organisations has your country partnered with or is partnering with in relation to Outer Space initiatives

_____

_____

18. Has your country received any financial or capacity building support from nations who have launched outer space objects from your country? Yes □ No □
19. Is your country a partner in any regional outers space collaboration within the continent

    Yes □ No □
20. What kind of collaboration is it?

_____

_____

_____

~Thank you for your participation ~

Appendix V: Questionnaire Administered to Key Informants from Other State and Non-State Partners in Cooperation on Outer Space Activities with Africa

(Please tick where necessary)

1. Name of your Country/Organisation _____
2. Is your Country/Organisation involved in any outer space activities in Africa?

   Yes □ No □
3. Does your country/Organisation have any laid out policies and regulations related to cooperating with other State and non-state space actors? Yes □ No □
4. Has your Country/Organisation delegated any funding towards supporting outer space activities in Africa? Yes □ No □
5. (For State partners only) What percentage of your country's economic budget is dedicated to Outer space activities?

   a) At a national level_____

   b) In cooperation with other States particularly from Africa _____
6. Has your Country/Organisation launched any space objects from Africa?

   Yes □ No □

   If yes, how many? _____
7. For State partners only) Has your country been a launch site for any space objects belonging to Africa? Yes□ No □

   If yes, please provide the countries' names? _____
8. Which African States has your Country/Organisation signed agreements with_____

   _____

9. Which multilateral agreements related to Outer space activities is your country party to in Africa _____

_____

_____

_____

_____

10. Do you think African countries are collaborating more with each other on Outer Space activities? a) Yes □ No □

    If no why do you think so?

    _____

    _____

11. Is there readily available data in your Country/Organisation on Outer Space initiatives in Africa? Yes □ No □
12. On a scale of 1-10, how would you say Outer space cooperation is important to your Country/Organisation? (10 being the highest importance/cooperation) _____
13. What are some of the challenges you can identify that African States face in their International relations in outer space activities?_____

    _____

    _____

    _____

    _____

    _____

    _____

14. What are some of the solutions you would recommend concerning the challenges you identified in number 13 above? _____

_____

_____

_____

_____

15. Which other International Organisations has your Country/Organisation partnered with or is partnering with in relation to Outer Space initiatives in Africa?

_____

_____

16. Has your Country/Organisation set up any platforms for knowledge sharing of technology derived from Outer Space activities with Africa? Yes □ No □

17. Is your Country/Organisation a partner in any regional Outer Space collaborations in Africa? Yes □ No □

18. If yes, what kind of collaborations are they?

_____

_____

_____

~Thank you for your participation ~

Appendix VI: Tentative Time Lines

January	Guidance to Proposal writing
February	Preliminary proposal and Chapter 1
March	Presentation of draft proposal
April/May	Submission of proposal for correction
June/July	Data Collection and Analysis
August/October	Compilation and Submission of Final report