



UNIVERSITY OF NAIROBI

INSTITUTE OF DIPLOMACY AND INTERNATIONAL STUDIES

**ROLE OF SCIENCE AND TECHNOLOGY IN ADVANCING NATIONAL
SECURITY IN 21st CENTURY, AFRICA: A CASE STUDY OF KENYA**

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REG NO. R 50/35385/2019

**RESEARCH SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT
FOR THE AWARD OF MASTERS OF ARTS DEGREE IN INTERNATIONAL
RELATIONS AT THE INSTITUTE OF DIPLOMACY AND INTERNATIONAL
STUDIES UNIVERSITY OF NAIROBI**

DECLARATION

I declare that this is my own original work and it has never been presented in any University or Institution for the award of any academic qualification

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ACKNOWLEDGEMENT

This proposal would not have been completed without the help, cooperation and contribution of my supervisor, Prof. Amb. Maria Nzomo, who owing to her long-standing experience as a scholar, guided me through the entire research process. Special acknowledgment goes to all academic and non-academic staff members of National Defence College for the discussions, valuable suggestions and contributions.

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LIST OF ABBREVIATIONS

<i>AMISOM</i>	African Union Mission in Somalia
ASAL	Arid and Semi-Arid Land
AU	African Union
CIOs	Chief Information Officers
COMESA	Common Market for Eastern and Southern Africa
HIV	Human Immunodeficiency Virus
ICT	Information Communication Technology
IT	Information Technology
ITU	International Telecommunications Union
KOFC	Kenya Ordinance Factory Company
R & D	Research and Development
SSR	Social Science Research
S & T	Science and Technology
TT	Technology Transfer
UK	United Kingdom
UN	United Nations
US	United States
USD	United States Dollar

ABSTRACT

The study explores Science and Technology and Insecurity nexus in Africa during this current century. Africa is rapidly developing in information communication technology (ICT) infrastructure and with this growth; more people have been linked to the network in a global setup. However, this advancement has also introduced key trends to the future of security tools and apparatus in the continent. The case study of Kenya was chosen because of the similarities in the African countries experiences of security challenges. Securitization Theory was adopted as the theoretical framework in analysing the philosophy behind science, technology and security measures, with a view to finding an analytical explanation as to why despite science and technology improvement, the security challenges continue been experienced in Kenya.

The study has employed qualitative research method and analysed data obtained from the field including the analysis of secondary data from various academic scholars, journals, publications and other academic works. The study investigated the communication policies, security strategies and mechanisms available and how they are influenced by science and technology. The respondents interviewed in this research include professionals in ICT technical roles, ICT security officers, IT administrators, academia, IT institutions and others. This research explores the measures and strategies applied in Kenya to safeguard the science and technology sector against cyber threats. These measures include developing cyber capacity and national institutions to cater for and provide a secure and safe cyber environment.

The study analysed how science and technology has influenced Kenya's national security. The research contextualized the concept of science and technology within the Securitization Theory context in order to appreciate S & T and its effects to national security. The highlight is on how country's security has become prevalent and its porous nature and complexity. The increase in usage of science and technology (S&T) especially telecommunication technology has been associated with the use of computers across the public and private sectors. This has attracted criminals to exploit the opportunities available. As outlined in the trends of insecurity presented, the attacks are sophisticated because of the asymmetric nature of operations. This provides a basis through which to evaluate Kenya's security position and how to use science and technology to enhance it.

The study therefore concludes that there is a strong relationship of correlation between the growth in technology and security. The study proves that legal frameworks that provide for information security do exist. However, the area of weakness is in implementation due to weak structures and lack of enforcement mechanisms. The country's S & T position therefore remained weak because of inadequate skills, ignorance and lack of cyber threat awareness amongst many internet users. However, there is a growing acknowledgement of the important role played by institutions through investing in S & T security as a major step towards enhancing security capacity. Finally, the research also provides recommendations on measures that can achieve sustainable S & T, which must be anchored on corporation of all stakeholders including internet users, researchers, policy formulators, conductors and executors.

CHAPTER ONE

Background of the Study

This chapter covers the background on the role of Science and Technology in advancing National Security in the 21st century, Africa, and the statement of the problem, research questions, and objectives of the study, literature reviews, justification, theoretical or conceptual framework, hypothesis or assumptions of my study, methodology, chapter outline and finally bibliography.

The most remarkable Stages in the history of humankind is innovations and self-protection. In the past, human beings either have defended themselves or have renovated equipment to ease their working. International security, security studies or strategic studies is a new subject of academic knowledge born towards World War II. The study was previously an autonomous area of study but was later incorporated in the wider scope of international relations. Security generally refers either to the measures taken mainly by States or their ability unilaterally or collectively to ensure mutual survival, peace and safety at regional and international levels. According to Brenner, the measures taken by States ranges from diplomatic actions such as treaties and conventions, economic, social and military actions; thus, international and national securities are intrinsically interdependent.¹ Security therefore incorporates a variety of global issues that threaten human security; the development of which is underpinned by scientific and technological improvement.

Brenner defines science as a systematic subject that builds knowledge in form of logical and analytical explanations, while technology refers to the processes and/or methods utilized in the creation of goods and services.² Science and Technology (S&T) drives development, security and the economy hence it is of primary interest to states and an enabler of international security and security. In addition, Science and technology denotes key activities and the processes that

¹ Brenner S. *Law in an Era of Smart Technology*, Oxford: Oxford University Press, (2007), p. 375.

² Ibid, (2007), p. 381.

lead to the generation of new knowledge, innovation, information and their application that lead to human advancement.

The African Continent continued to face myriad of security challenges that had habitually remained the same up to 1989, the time and era when Cold War was ending. Despite other security issues on criminality still remain, lately, there has been a noticeable shift from intra - state conflict to more specific phenomena of security threats ranging from violence to human insecurity.³ Cummings (2015) note that the ever increasing challenges of proliferation of small arms and light weapons (SALW), drug trafficking and emergence of non-state actors such as Islamic militant groups continue to pose serious insecurities and instability in Africa and the approaches being taken to address these threats sometimes end up making the situation worse.⁴

Mwagiru (2004) says that, “Security challenges should be addressed within the ambit of a democratic process, promotion of human rights, good governance and the creation of a culture of accountability and transparency in the management of security sector process”⁵. The aftermath of Cold War period was preceded by globalization, which brought with it global market, global society and global culture. It also brought with it a unique character to the world social economic system. Through globalization, the world is becoming borderless with increased illegal networking and interactions that makes it easy for illicit trade in drugs, transnational crimes, arms trade, human trafficking and money laundering among others. Efforts to mitigate against these security challenges meet stiff resistance emanating from illegal networks that drive them due to the environment created by globalization.⁶ It is against this background, that the consideration of what constitutes security must also widen and take

³Chimera J. M AND Luchetu L (2014)*Community policing implementation by Security agencies in Njoro sub-county, Nakuru, Kenya*,www.IJSK.org/uploads/3/1/1/7/31174313-community.Dec.2014 . vol.4, No.8 International journal of research in social sciences ISSN2307-227X.

⁴ Ryan Cummings (2015), *what security challenges face sub-Saharan African in 2015?* IPI Global Observatory. www.the-global-observatory.org/2015/security-challenges-Sub-Saharan-African accessed 28th August, 2015.

⁵Mwagiru M. (2004) *African Regional Security in the Age of Globalisation*, Heinrich Boll Foundation

⁶ *ibid*.

cognizance of new threats emanating from external non-state actors. It is this new phenomenon, which Agostinho (2003) argues that it has negative impact in the new international security system that is already eliciting fundamental issues that set the agenda in today's post-Cold War security framework.⁷

The concept of security sector reforms emerged in 1989 to address the increased scope that traditional security approaches did not effectively address. The definition of security has also widened to include health, food, employment, economic growth and many other spheres. The problem partly is due to the way the state perceives security as its only domain. They did not see to possibility of security be provided by private military firms, mercenaries and other non-State actors. According to Giesmann (2005), social security is a concept created to respond to a myriad of security situations. During the cold war era, State paid less interest to accountability, transparency, observance for rule of law and focused on the enhancement of programmes that would boost cold war operational capacity in disregard of the democratic governance that would observe the security. However, this form of approach to security challenges lost support in the new world order more prominently in the 1990s with the emergence of other actors such as donor communities who pegged their assistance to good governance and rule of law requiring reforms of the security sector. Mostly affected amongst were the developing countries that were in the process of transitioning to democratic governance based on rule of law when cold war ended. In the same note, the donor community called for reformation of the military, police, customs, intelligence services and the penal code system to be accountable and effective if development and democratization were to succeed.

The advent of S&T gave birth to the innovation and development of new weapons systems, the concept of cyber space, nuclear proliferation and arms race as states sought modern systems

⁷Agostinho, Z (2003) *Redefining Security from Cape to Congo: Southern Africa's Evolving Security Challenges*, Colorado: Lynne Rienner.

characterized by reach, precision and lethality aiming to address the emergent threats to security in an era of global uncertainty. The early 21st century saw an unprecedented growth of technological change, especially in telecommunication and information technology. Whereas this gave rise to globalization and interconnectedness that have a myriad of advantages in security related issues, it also led to challenges an example of which may be seen in cyber insecurity and other network related insecurity issues which currently poses serious unconventional and transnational threat to the international system. This in effect has led to a shift in the formulation, conduct and execution of international relations, and the practice of international security. Both States and non-state actors now have equal influences on a much more level technological field thereby significantly changing the global power distribution paradigm.⁸

In addition, Science and technology has led to new discoveries ranging from the internet to drones, new varieties of crops, better health care and the potential application of this technology is enlarging into aspects of security.⁹ For instance, in the study of peace and security, new technology can help prevent conflict by reducing the reaction time between early warning and response, hastening peace-building processes by empowering local actors and helping the improvement and development of disarmament systems. This is enhanced by the media, which directly influence public opinion. Klaus notes that S&T has aided countries greatly to effectively “inform and respond to changes and continues to play a decisive and beneficial role in advancing the security of the society”. However, despite these advantages, there are also major threats to ‘national and international security systems.’¹⁰

In conclusion, the place of Science and technology in the global industrialization and development discourse is significantly weighty and reaffirms the need for the investment and

⁸ Glanz, James. *Power, Pollution and the Internet*, New York Times, (2012), p. 12.

⁹ Sachs, Jeffrey. *The Age of Sustainable Development*, New York: Columbia University Press, (2015), p. 82.

¹⁰ Klaus, Schwab. *The Fourth Industrial Revolution: What It Means, How to Respond*, World Economic Forum, (2016), p. 56.

integration into social-economic and governance related policies to insure states' global economic competitiveness. Science and technology is interlinked with many phenomena relating to international relations, including conflict, economics, social and culture although the linkage connecting global politics and technology still remains under-valued.

For many years, the evolution of technology has had impact on global politics greatly, security, diplomacy, the environment and even before the study of international security emerged. Innovation, creativity and economic utilization of inventions are high priorities in governments' development agendas and roadmaps. Science and technology is the most prominent component of the states' development agenda as countries have realised that for growth to be achieved Science and technology has to be adopted. It is therefore inconceivable to think of any international or global issue in total exclusion of scientific or technological aspects.

1.2 Statement of problem

African countries have their National Security as a persisting problem. In Africa, insecurity is rampant and occurs in various forms and types. There are interstate and intra state conflicts. In the past, Science and technology has been a missing factor in the effort to manage security. In my view, absence of investment in science and technology has contributed to Africa's incapacity to combat insecurity for example terrorism. Failure to advance science and technology may have enhanced cyber insecurity, anti-bank fraud, money laundering and multidimensional security complexities.

Situation of peace and security has been hampered by inability to prevent, protect, pursue and respond. Prevention that is reactive to contain insecurity can be addressed by enhanced investigation and pre-emptive approaches. Protection is the control of the damages to both human and property during the attack. Pursue is the ability to follow up the perpetrators from the source and the root causes. Respond is proactive actions after the attack has taken place to enable the system under attack to resume work. Innovations in science and technology will

effectively improve efficiency and performance of the Security agencies during the four named stages. The institutions of police and judiciary will work more effectively in investigations and administration of justice. \technology on the digital government will aim at transparency and accountability.

In Africa, food production methods are indigenous and production is indeed very low. To address food insecurity, there is need to invest in technology to produce high yielding seeds and variety of foodstuffs. Investing in plant and animal husbandry through scientific improvement is likely to counter food deficiency. Health insecurity like corona virus may be addressed by intensive science and technology in laboratories trying to come up with cure.

Opening portals that are accessible by the public can address insecurity by incorporating everyone in the fight to combat it. Science and technology investment will provide Africa with oversight of the insecurity issues in globalization era.¹¹

1.3 Research Question

- i. What have been the trends in managing security in Africa?
- ii. What has been the role of Science and Technology in advancing Kenya's National Security?
- iii. What challenges and strategies have been put in place to address and harness Science and Technology in advancing National Security?

¹¹Transparency International Defence and Security Programme (2013) *Defence and Corruption*; Transparency International UK is a chapter.

1.4 Objectives

The objective of this study is to establish the role of Science and technology in promoting National security in 21st Century, Africa: A case study to Kenya.

To analyse the trends in managing security threats to Africa.

To assess role of Science and technology in advancing National Security.

To assess the challenges and strategies that have been put in place to address and harness Science and technology in advancing National Security in Kenya.

1.5 Literature Review

1.5.1 Introduction

This literature review is analysed from the study of National security in Africa. Later the study explores literature on how S&T is used in enhancing security in the continent, types of Security threats traditionally and contemporary. Justification for use of S&T to enhance security in Kenya.

1.5.2 Literature on National Security threats in Africa

The collapse of the Cold War changed the perception that security could only be viewed with the prism of inter-state violence. With the system changes in the international security structure, states ceased to be the only actors with exclusivity in the handling of security issues. On the other hand, the citizens reduced faith that governments are able to provide the needed protection to them singly. The concept of globalisation enhanced by modern technology has brought about the emergence of new form of insecurities, which are of transnational in nature. Some of these contemporary insecurities include drug and human trafficking, poaching, money laundering and cybercrimes. Through globalization, states are becoming borderless and interconnected in a way hence enhancing better working relations and interactions between states and societies. Another effect can be attributed to globalization is the emergence and

advancement of information age and telecommunications. This phenomenon has exposed the world to non-traditional security threats facing many African countries today.¹²

Mwagiru (2004) argues that many security threats experienced of late are complex and the traditional state-centric security policies adopted by authorities cannot handle them adequately because of their nature. The nature how they present themselves appear risky and vulnerable. This problem is further exacerbated by threats emanating from external non-state actors such as extremist religious groups.¹³

There are concerted effort to eliminate the cycle of threats to societies in Africa though, a number of gaps still exist with different perceptions of these challenges being very evident. The attention shifts to the state in which elections are used as a means of legitimizing elected governments whether democratic processes are exercised or not. Institutions of governance are used to enhance and facilitate the election and due to this, African Governments are unable to manage security agencies that would guarantee security to all citizens and their properties, a situation that has allowed alternative security agents inform of militia and vigilante groups and private security firms to come up and fill the gap.

The type of insecurity threats and challenges that emerged after the cold war era adopted similar characteristics among African countries arising from common historical background. Adejumobia and Olukoshi (2008) argues that, countries like Sierra Leone, Liberia, Mali and Guinea Bissau, experienced none international armed conflicts due to authoritarian rule. Nigeria, on the other hand suffered political instability following successive military dictatorial regimes and considers some of the security problems that cause insecurities in Africa as collapse of government institutions as witnessed in Liberia, Somalia, Sierra Leone and Congo. Inter communal rivalry emanating from community conflicts, emerging conflicts over control

¹²Beal, Clifford (2002), *'Everything Has Changed Nothing Has Changed'*, Vol. 38, No. 11, pp. 8 - 9.

¹³Mwagiru M. (2004) *African Regional Security in the Age of Globalisation*, Heinrich Boll Foundation.

ownership and management of community natural resources, inequality and proliferation of small arms and light weapons originating from Western European market through non-state actors and unscrupulous manufacturers.¹⁴

Dylan (2009) recommends several approaches for employment to address these perennial challenges in security but these attempts have resulted in success and failure in equal measure. Prominent among these approaches is the promotion of good governance initiatives such as through electoral bodies and reforming institutions of governance which in many cases include security reforms.¹⁵ Kimani (2012) asserts that meaningful security can only be realized when all the challenges are discussed, analysed and addressed through reformation. This must focus on long term and sustainable solutions involving states, non-state actors and individuals and at the same time considering the efforts of regional and global mechanisms.¹⁶

Adjumobi and Olukoshi (2008) cite Natural calamities such as drought that lead to famine, mismanagement of natural resources and the effect of endemic diseases like HIV/AIDS continue to threaten health of many African youth who would ideally form the next generation of human resource that the continent would depend on for its security.¹⁷

The proponents of human security observe that one of the common challenges affecting human security in most African countries is the fact that states have the tendency to prioritise State security and physical protection of elites in the society with little attention to the common people they are supposed to serve. This observation is supported by human security practitioners who feel that security of citizens should be given preference before the state,

¹⁴Adejumobi S, Olukoshi O (2008), *The African Union and new strategies for Development in Africa* Cambria Press, Amherst, New York, p 348-353.

¹⁵Hendrikson, Dylan (2009). Key Challenges Facing Security Sector Reform: A Case for Reframing the Donor Policy Debate.” Conflict, Security and Development Group Working Paper.

¹⁶Kimani, M. (2012). Security for the Highest Bidder: Shoddy Policing for the Many, Costly Private Protection for the Few.” Accessed on May 20, 2012 at http://www.un.org/en/africarenewal/vol23_no3/233-security.html.

¹⁷Adejumobi S, Olukoshi O (2008), *The African Union and new strategies for Development in Africa* Cambria Press, Amherst, New York, p 348-353.

hence the need to reform the security sector with emphasise to security needs of individuals, protection of homes and property and assurance of good living conditions of the citizens¹⁸. According to Ball (2014), in Africa, the concept of Social security was introduced to offer solutions to various states facing security dilemmas. However, there is not a success story of the concept so far. In Burundi, human security though still in progress, is credited for having advanced both security sector and democratic accountability since 2009 when the programme was initiated. The success of Social security depends on the ability to handle politically controlled issues and this explains why these programmes have been unable to take off in many states in Africa. The challenges noted in Burundi case can help and inform other such programmes in Africa.¹⁹

Johnson (1994) referring to ideal liberal theory observes that in modern societies, the state plays a key role in shaping the lives of individual citizens but may not necessarily be in a position to adequately provide all other needs including security. It has the ways and means to regulate how individuals do certain things as governed by set rules and regulations but even though the state has the capacity to establish institutional structures for change and reforms, it might not be the most suitable or most preferred social arrangement mechanism to provide the best solution to the existing problems.²⁰ The state therefore requires arrangements for an all-inclusive arrangement involving all actors if the challenges facing security sector reforms are to be addressed effectively. Giesmann (2005) argues that in order to achieve good social security results, the involvement of the following actors is critical; individual citizens, educated public, professionals, Non-Governmental Organizations (NGOs), International Organizations (IGOs), International community led by the United Nations (UN) and private sector. The participation

¹⁸H JGiesmann(2005) *Human Security and Security Sector Reform: Contrasts and Commonalities*. Security and Peace, Vol. 23, No. 1, Human Security.

¹⁹Nicole Ball.*Lessons-from-burundis-security-sector-reform-process*; (Washington DC Africa Center for Strategic Studies2014).

²⁰David Johnston) *The Idea of a Liberal Theory: A Critique and Reconstruction*. US ,Princeton University Press(1994), Princeton, NJ. Publication.

of such actors allows partnership and ownership especially by the public from the planning stage throughout the implementation process. In any case, it should be a joint ownership for all. The public understands and appreciates that security needs of the state, those of individuals differ in nature, and not all security issues will require a solution from the state, as the public and other actors will offer some solutions too.²¹

It is observed that while it is important to take cognizance of the growing need and importance for all security aspects, there is high preference for security assistance devised programmes that focus on equipping security organs and training without much attention to governance and the rule of law. Friedan argues that many security programmes lack the desire or the capacity to transform the countries into initiatives intended to improve the democratic governance of the sector.²² Kenya experiences similar insecurities as in other African countries such as food insecurity due to draughts; poor farming methods and environmental challenges but human security, health and even job security are of major concerns to security in the country. Mwangi (2004) says that human security is of great concern in Kenya because security sector has been intimately been accused of gross violation human rights. “The security apparatus need to focus on the constitution, legal structures and policy changes that may be required to infuse the principles of accountability, professionalism, and efficiency into a security sector”.²³

Cummings (2015) argues that the worst phenomenon that many countries in Africa are grappling with now is Islamic extremism and radicalization. In the Sahel region of the Western part of the African Continent, the security challenge is driven by the emergence of extremist groups whose agenda is to replace secular state regimes with authoritarian systems based on the Islamic sharia doctrine. Despite intervention initiatives by France, African Union and UN, the

²¹Giesmann H J (2005) *Human Security and Security Sector Reform: Contrasts and Commonalities*. Security and Peace, Vol. 23, No. 1, Human Security.

¹⁷Sicherheit&Frieden (2005) *Human Security and Security Sector Reform: Contrasts and Commonalities*. Security and Peace, Vol. 23, No. 1, Themenschwerpunkt.

²³Mwangi M. (2004) *African Regional Security in the Age of Globalisation*, Heinrich Boll Foundation.

Islamist fighters in Mali's vast desert whose capabilities were thought to have been downgraded, staged a bloody come back killing 30 UN peacekeepers in 2014. Currently Boko Haram, the extremist militants group in Nigeria, launched a bloody insurgency operation and in 2014 captured large swaths of Nigeria's North Eastern States of Adamawa, Borno, and Yobe. From 2014, the Nigerian security forces have been struggling to contain the spread and transformation of the group with little success.²⁴ The only left weapons of choice to contain these insurgents groups is the use of Science and technology to prevent, protect, pursue and respond.

In the horn of Africa, Al-Shabaab Islamist extremist movement based in Somalia is likely to continue influencing the political development in the East African Countries more so in Kenya and Ethiopia. In 2014, the group intensified their violence activities targeting unarmed non-Muslims and churches in North Eastern and the coastal region of Kenya with the aim of heightening the ethno-religious differences in the Kenyan Society. Cummings (2015) further argues that Al-Shabaab is likely to continue its tactics of targeting persons based on religious orientation if the Kenya Government does not change the counter terrorism approach applied that discriminately targets the Muslim population.²⁵ To assist in counter terrorism, Kenya will need to use the most appropriate Science and technology to counter radicalization, and counter extremism.

Kenya is affected by the changes in the global arena in the 21st Century. Demands for democratization processes in Africa especially in the last two decades and respect for rule of law and increased level of awareness by the society calls for change of approach for addressing security needs. As a result, the notion that national security is state centric, security without

²⁴ Ryan Cummings (2015) *what security challenges face sub-Saharan African in 2015?* IPI Global Observatory. www.the-global-observatory.org/2015/security-challenges-Sub-Saharan-African accessed 28th August, 2015.

²⁵ *ibid*

consideration of the common wellbeing of the citizenry has to be reviewed to embrace the new world order.

In Kenya, there are attempts to ensure citizen security is informed by the changes that target security management. These have contributed to the change from state-centered to human security entailing a corresponding transformation in the way security managers are handling the reforms. Various forms of CCTV, biometrics, electrical detectors, and anti-cyber reforms inform these reforms. Investment has been made to improve all aspects of security. The questions one may ask is how these reforms have affected the management of security systems in Kenya and how these institutions have adapted to these changes. The expectation is that there is restructuring and new techniques in place to adequately respond to the aforementioned challenges. The security sector reforms involving Science and technology taking place in Kenya are some of the institutional transformations the government has embraced. The constitution of Kenya 2010 now includes individual liberties and freedoms as reflected in the Bill of Rights. It also recognizes the importance of Science and technology in enhancing security. This is expected to influence the public perception of their right to live in a secure environment with guaranteed security by the State within the ambit of the Law.

According to Wanyama (2013), the Kenyan security reforms should ensure there is no repeat of previous injustices and bad precedence by security agencies and suggests changes of effective administration and management skills and expertise in the sector. He observes that there is need for a shift towards enhancement in accountability, transparency, professionalizing the security system, institutionalization and more elaborate role of the legislature. The objective this integration aims to achieve the establishment of democratic institutions with a well-defined structure for the country's security²⁶. Before 2010, Security reforms in Kenya were ad hoc and

²⁶ Leonard Wanyama (2013). *Reforms and Kenya's security sector debates* www.africanscene.co.za/2013/02/reforms-and-Kenyans-Security-sector-debates accessed 29 August 2015.

used crude technology but the promulgation of the constitution in 2010 brought in changes that included specifying authorities to establish organs with clear functions and powers by pronouncing new threshold for appointments into office and civilian oversight through the establishment of an independent authority. The oversight cannot be effective without the necessary technological backup.

The only shortcoming is the nature of security structure that would conform to the devolved government and the skills required in handling of the technological enablers. The use of technology has led to the feeling of lack of inclusivity that has led to blame game at the both country and county level whenever insecurity incidences occur. The contestation here is brought about by the way institutions are established against the perception of the public who are now able to monitor and raise public opinion as aided by the electronic and print media and other actors. The institutions demands safeguarding of integrity of security operations and structure. This is very difficult in this era of reporting, transparency and technological overlook. The public and other actors feel there should be a move towards a policing structure that responds to the expectations of the public that are legitimate and accountable of their actions.²⁷

Luchetu (2014) argues that cold war contributed to heightened insecurity in Africa and Kenya wasn't exempted. Kenya faced the myriad of challenges ranging from human security beginning 1990s to petty crime and tribal rivalries. This was further aggravated by abuse of office, unacceptance of reforms, rampant corruption and misinterpretation of the constitution for selfish gains. The politicization of security organs created a feeling that security was only a preserve of the privileged elite and this led to the creation of private security companies and emerged vigilante and militia groups in the urban slums and rural areas.²⁸The fact that violent

²⁷Leonard Wanyama (2013) *Reforms and Kenya's security sector debates* www.africanscene.co.za/2013/02/reforms-and-Kenyans-Security-sector-debates accessed 29 August 2015.

²⁸ Chimera J. M ,Luchetu L (2014)*Community policing implementation by Security agencies in Njoro sub-county, Nakuru, Kenya*,www.IJSK.org/uploads/3/1/1/7/31174313-communityDec.2014.vol.4, No.8 International journal of research in social sciences ISSN2307-227X.

and criminal activities continue to impact the well-being of the individual and habitual breaking of the law by the citizenry of Kenya is a clear indication that reformation and technological adoption of security is far from being realized in Kenya.

1.5.3 Literature on Science and technology policies

Science and Technology (S&T) are essential ingredients to the generation of knowledge and skills that underpin development objectives locally, regionally and internationally. An effective science and technology infrastructure is imperative, necessary and enables nation-states to fully harness the potential of modern science, technology and innovation to ensure socio-economic development and especially security. Science and technology has since the industrial revolution in the 19th century advanced significantly and transformed the socio-economic and security development of the society. The 21st century advancement in Science and technology not only explains the development gap between the developed and developing countries but also is reputed for major break-through in any development. This is particularly in information technology, mechanical, civil engineering, communication and transportation that have been the driving forces of globalization.

The sustainable investment and integration of Science and technology into socio-economic and security policies has the potential to promote Kenya's global competitiveness, increased productivity and employment whilst creating a secure environment for social and economic development. In this regard, Kenya enacted the Science and Technology Act in 1977, which was amended in 1979 to enable formation of institutes for research in the Agricultural, Industrial, Marine and Fisheries and Medical sectors.

1.5.4 Literature on the Use of Science and technology in Security

There is increasingly appreciation of the important role that Science, Technology (S&T) and Innovation plays in attaining sustainable economic development. Lidia Brito argues that for

Science and technology to be a driver for sustainable development goals, development agendas for countries should be issue and people-centred, and avail environment that allow the full potential of Science and technology to be adequately harnessed.²⁹ These two concepts are interwoven in order to achieve optimal outputs that can improve livelihood in countries, particularly developing countries like Kenya. Lidia Brito further opines that, “the implication of this is that countries need to develop, innovate, implement and monitor their national Science and technology policies and programs that promote knowledge production, dissemination and utilization as well as the development and appropriation of indigenous technologies that spur innovation.”³⁰ For greater impact, such appropriate innovation should not only be domiciled in large companies and industries, but should also percolate down to the lower levels. This however, means that a structural framework to develop human capital, knowledge and skills must be aligned with knowledge-based society.

However, success will be determined with the available infrastructure, nature of governance, will to change, accountability issues within the various sectors and favourable investment climate.³¹ Economic growth has direct effects on the security, security is actually a incentive for growth.

The application of Science and technology from space via satellite to Nano technology has introduced new dimensions of risks into business enterprise. Unfortunately, cyber insecurity and its risk is not conventional, increased criminal activities and the likely rise of new diversities of illicit actions continue to present challenges to legal experts and security agents alike.³² Whereas the technological infrastructure development underpin the possible answers to the increasing numbers of regional and global issues confronting many states, technology has

²⁹Lidia Brito. *The Role of Science, Technology and Innovation Policies and Instruments for a Paradigm Shift Towards Sustainable Development*

³⁰*Ibid*

³¹ Ernesto Pernia et al. *The Role of Science, Technology and Research in Economic Development*

³² Brenner, Suzan. *Law in an Era of Smart Technology*, Oxford: Oxford University Press, (2007), p. 375.

repeatedly proven the possibility of disrupting the international security landscape and nothing seems security proof.

The importance of modern science and technology in security and the global politics is exemplified by the Iraq war in 2003 where the techno-military dominance was clearly displayed by the successful application of high precision weapons without comparative advantage.³³ The remarkable displays of the new defence technologies pre-empted and predetermined the results of the operation. In light of this capability, other nations in Europe, Asia and Africa are now appreciating technological leadership in military research, development and innovation as a sustainable competitive means to build the capacity for the burgeoning international security threats.³⁴

The African countries success in enhancing their national and international security may largely depend on how they harness and incorporate science and technology in their respective national security and development strategies. However, the 21st century international security issues and threats of non-traditional nature such as terrorism, cyber security, laundering, fraud and trans-boundary crime will continue to attract attention in African Union and other sub-regional organisations Peace and Security Architecture (APSA) to respond to the various security challenges that threaten the continent.³⁵

Science and Technology are key enablers of industrialization, security, and sustenance of socio-economic growth of any country. The deliberate innovations, investment and integration of Science and technology into the social, economic, security and governance will not only increase the developing countries global competitiveness but also will enhance job creation and improve standards of living thereby contributing to gainful employment leading to a reduction

³³ Held, David and McGrew, Anthony. *The End of the Old Order?* Review of International Studies, No. 24, (1998), p. 219-243.

³⁴ Ibid, (1998), p. 245.

³⁵ African Union. *Protocol Relating to Establishment of the Peace and Security Council of the African Union*, as adopted in Duban, (2001), p. 56.

of insecurity and an increase in productivity.³⁶ The significance of Science and technology on human security has been profound and yet desirable to alleviate the existing and emergent threats such as water scarcity, food insecurity, health insecurity, declining sources of energy and the negative effects of climate change. For example, the human race continues to suffer from many incurable diseases like HIV/AIDS, Malaria and Cancer amongst other deadly diseases. Their cure and complete eradication from the surface of earth can only be achieved through scientific research. In addressing the issues of unemployment, poverty alleviation and industrialization, governments must invest heavily in R&D of various technologies to ensure higher agricultural productivity through irrigation of ASALs and modern land use whilst preserving the environment as well as in the search for new sources of renewable energy.

On the security landscape, the intensified acquisition of technology as a threat to potential adversary through transfer and its application is important in upstaging efficiency and productivity cascading through political, security, and socio-economic pillars in Sub-Saharan Africa and other developing countries. Technological innovation transfer is the procedure by which essential science research and crucial revelations are created into practical and commercially pertinent applications and items (products).³⁷

According to Rober, transferred defense technological innovations have an impact on national security and regional stability. Defence technology is the understanding, usage and the utilization of specific knowledge, and technical information.³⁸ Developing and importation of defense technologies is therefore inevitable for enhancing Africa's capacity to generate sustainable development and upgrade national security. Science and technology is vital to the

³⁶ Mugabe, John. *Centers of Excellence in Science and Technology for Africa's Sustainable Development. Towards New Forms of Regional and Sub-Regional Networks*. Paper prepared for the African Ministerial Conference on S&T for Development, (2003), p. 117.

³⁷ Casper, Steven, Lehrer, Mark, and Soskice, David. *Can High-Technology Industries Prosper in Germany? Institutional Frameworks and the Evolution of the German Software and Biotechnology Industries*. Industry & Innovation, (1999), pp. 6-26.

³⁸ Rober, Philips. *Technology transfer: A Policy Model*. National Defence University, Washington DC, (1988), p. 25.

generation of critical knowledge that essentially leads to the promotion of development in various sectors from the international to local levels.³⁹

The contemporary evolution of science and technology focuses primarily on the existing knowledge and integrates to a combination of existing tactics incorporated into multiple systems utilizing advanced capabilities and platforms to guide precision weapons. Information warfare, imageries, cyber warfare, electronic warfare, pilotless aircrafts, integrated intelligence and early warning systems and others reflect a few of the emerging tools of technology in the modern warfare. By integrating information with weaponry, a state, which has adapted technology to its defence, can enjoy a dominant situational awareness in the battlefield and therefore cannot be surprised.⁴⁰ Notably, the perfect blend of science, technology and innovations with military doctrine can provide enormous comparative advantage to a states' combat power. Kenya's realization of the role of Science and technology into social - economic and governance policies and strategies will contribute to her aspirations to a middle-income industrialized country by the year 2030. This achievement will be a major step towards the creation of a conducive economic environment, job creation, inequality and a reduction of poverty thereby reducing national insecurity and as consequence, contributes to effective international peace and security maintenance.

Through the application of Science and Technology, various societal needs were addressed and further lead to the creation of industries. The motor armored vehicle and biotechnology industries amongst others are examples where S&T played a key role to their establishment and continuesrelying on it for security, growth and innovation.⁴¹ In South Africa for example,

³⁹Obudho, Rose Aduwa. *Urbanization and Sub-Urbanization Processes over Time and Space*. Kenya, (1999), p. 87.

⁴⁰Kalu, Ann. *The Causes of Conflicts and Promotion of Durable Peace and Sustainable Development in Africa*. Report of the UN Secretary General to the Security Council. New York, UN Department of Public Information, (1998), pp. 3-7.

⁴¹Lars, Skyttner. *General Systems Theory: Problems, Perspective, Practice*. World Scientific Publishing Company (2006), p. 17.

subcontracting in defense industry gained prominence after independence. In Kenya, Kenya Ordnance Factory Company (KOFC) Specialised in ammunition calibration and manufacturing is a good example of defence industry. However, through the mainstreaming of Science and technology into the national security strategy, more defense industries could have been created.⁴²

The comprehensibility of international security in the 21st century with Science and technology cannot be over emphasized. However, as long as the possibility for catastrophic cyber-attacks against critical infrastructures appear likely to occur, of concern is the protection of both our hard and software infrastructures? The concerns must always remain and thus the need for the acquisition and application of technology in the enhancement of national and international security.

Scientific and technological information is also a critical element of global governance particularly in the establishment of international rules of conduct, the application of treaties and the implementation of the specialized agencies of the United Nations. It is through Science and technology that the world has been globalized, markets have been created and the improvement of transportation has led to the “death” of distance. In order to address Kenya's socio-economic bottlenecks and as well as attain effective a transformation in an economy based on the knowledge, Science and technology was prioritized in the establishment of technological domains aimed at the enhancement of economic and productivity growth. Kalu points out that “the strategic technology platforms will be comprehensive and sufficiently broad in scope to support development outcomes in a wide range of sectors.”⁴³ Examples include the mobile money platforms like M-Pesa, Airtel money in Kenya and Paga in Nigeria respectively that

⁴²Ibid, (1999), p. 34.

⁴³Kalu, Ann. *The Causes of Conflicts and Promotion of Durable Peace and Sustainable Development in Africa*. Report of the UN Secretary General to the Security Council. New York, UN Department of Public Information, (1998), p. 11.

have alleviated key transactions problems for millions in their respective countries and across several continents of the world.

African countries experience national security threats related to border disputes, inter-state conflicts, large uncontrolled movement of armed groups and mercenaries across borders. Also included in the list of threats to national security in the continent are organized trans-national criminal activities like narcotics, arms, human trafficking, money laundering and fraud. Conflicts within the nations have been associated with the marginalization of some communities or group of people in governance, decision-making, and exploitation of natural resources, ethnic, unequal distribution of wealth, religious differences and politics. To achieve the peace needed for development and for the continent is to be independent, united, and prosperous; it has to enhance Science and technology.

Bernanke contends that generation and commercialization of ideas is primacy to innovation. However, commercialization of such ideas alone is not good enough to spur development if a country is to forge forward in development. The support by the government is a necessity if development and sustainable growth is to be realized. The involvement of government through the provision of funds and policy support or offer tax incentives is key. It is further argued that the government should not just provide funds, but should also be involved to ensure that certain types of research and development R&D critical for the development of the country are conducted. The emphasis is that government funded researches are generally accepted and have the ability to lower overall cost of the research, and the eventual outcome has the propensity to benefit more people than if such research were privately conducted and funded.⁴⁴

The discourse about the role of government in Science and technology, the World Economic Forum report states that governments are increasingly getting involved with indigenous

⁴⁴Ben Bernanke. *Promoting Research and Development: The Government's Role. Journal on Science and Technology. Vol 27, No 4 Nov 2011*

innovations in order to trigger economic growth, which is a clear departure from the traditional role that governments only get involved when the market situation is shaky. In recent times, active involvement of governments in innovation through funding, research and guidance has led to advancement in technology. In many new fields such as green tech, biotech and nanotech, for instance, the involvement of the US government in the creation of Silicon Valley as a strategic investor through networks such as missiles industries, National Aeronautical Space Agency (NASA) and Defence Research Agency among others has been responsible for the development of innovative technology in the US. The argument here is that joint private and public venture-capital fund is the ideal source of funds for innovation. Other countries have adopted the same practice. Government funded Nokia, the leading Finnish communication company. Government owned banks also funded Huawei and Yangli Solar.⁴⁵

There is growing consensus for strategic collaboration between the government, academia and the private sector. Ranga and Ezkowitz posit that future growth and prosperity of countries lie in strategic collaborating and co-opting rather than competition, particularly in this dynamic era that is knowledge driven. They further argue that, “this partnership concerns different mechanisms of institutional restructuring of development path of innovation and innovation systems and in the formation of hybrid organization from the university, private sector and government that generate new institutional and social structures for the production, transfer, transformation and application of knowledge”⁴⁶. It is the contention of Ranga and Ezkowitz that such collaborative networks have the potential to promote creativity within each of the three institutional sectors of government, industry and academia.

⁴⁵ World Economic Forum. *What is the Government's Role in Sparking Innovation?* Available at: <https://www.weforum.org/agenda/2015/04/what-is-governments-role-in-sparking-innovation/>. Accessed on 4 Aug 2017

⁴⁶ Marina Ranga and Henry Ezkowitz. *Triple Helix Systems: An Analytical Framework for Innovation Policy and Practice in the Knowledge Society*. Available at: https://triplehelix.stanford.edu/images/Triple_Helix_Systems.pdf. Accessed on 4 Aug 2017

The reviewed literature in this study indicates that science, technology and innovation are key to sustainable development of any country. However, collaboration and co-operation between various stakeholders is critical if development is to be achieved. These stakeholders, among others, include government, academia, individual innovators and the private sector. The literature revealed that such collaboration has been responsible for economic growth in many developed countries from which developing countries must copy. In Kenya, cross sector, collaboration would not only help trigger innovation, but would promote the application of science, technology and innovation to national security, economic growth and social development. This research thus aims to determine the extent to which science technology has influenced National Security in Kenya.

1.5.5 Gaps identified in the literature

The literature does not fully address the various attempts made in Kenya to strengthen its security challenges. The literature has attempted to address the use of Science and technology in addressing various security threat but it falls short of giving mitigating factors to completely address security challenges. There are emerging security issue in 21st Century that the literature fails to mitigate solutions. The thorny issue of radicalisation and counter terrorism in my personal opinion is not comprehensively addressed. However, there is need to seek partnerships with developed actors that can respond to emerging issues, (Kigen et.al.2014, 41).⁴⁷ While the country has made several impressive efforts towards this, there remains more action to address the growing in-security threats in Kenya and the East African Region as a whole.⁴⁸ There is a need for a more scientific practical approach to strengthen the existing processes as well as

⁴⁷ Kigen, P. C. Kitsutsa, C. Muchai, K. Kimani, M. Mwangi and B. Shiyayo. 2014. "Kenya Cyber Security Report 2014." Available www.serianu.com/KenyaCyberSecurityReport2014. Accessed 10 June, 2018.

⁴⁸ Cassim, F. 2011. "Addressing the Growing Spectre of Cybercrime in Africa: Evaluating Measures Adopted by South Africa and Other Regional Role Players." *Comparative and International Law and Justice South Africa* 44:123-38.

build capacity to deal with emerging issues.⁴⁹ This reality remains grievous today and it is for these reasons that this study aims to analyse how science and technology can be used in advancing security in Africa, using a case study of Kenya.

1.6 Justification of the Study.

This study has two justifications: academic and policy

1.6.1 Academic Justification:

Kenya as a country is yet to give attention to Science & Technology (S&T) as viable option towards achieving its national security as compared to other African countries like Nigeria, SA, and Ethiopia. Science and technology is usually borrowed, harnessed and upgraded to suit the intended security purposes. Despite that technical knowledge is borrowed from western and developed world, it is upon the user to develop software to comply with what is intended to address of it. This study aims to introduce local innovations and add new knowledge on how Science and Technology can be harnessed and utilised to advance National Security.

The contemporary world is characterized by many securities challenges, the handling of which require strategies focusing on effective ways to deal with them. In this regard, the study seeks to add new scientific knowledge to the existing aimed at increasing capabilities and capacities of the African countries to effectively respond individually and collectively to these challenges. Kenya education curriculum and innovation system does not seem to address or serve the national security requirements. Most of the technology in the country is imported and does not fit into our technological requirements and ownership of the same is lacking. The Kenyan government therefore need to adopt new appropriate innovations that will ensure education, research and development system, intermediate organisations and S&T frameworks work in harmony.

⁴⁹ Ibid.p9

1.6.2 Policy justification:

The study intends to come up with and contribute ideas towards policymaking. The specific areas of knowledge that are going to be generated will be recommended for policy action. These ideas are informed by the understanding of the changes in the international security systems. They will also influence the management of security in Africa. The scholarly and professional views included in this study are meant to understand, analyse and interrogate earlier studies and create a better understanding of security challenges facing Africa and in particular to Kenya and various mechanisms being applied to address the insecurity. The study also aims to review various literature in order to increase greater appreciation of scholarly views provided about the changing global security environment and its impact on the management of security with the involvement of both state and non-state actors and civil society in Kenya. This study aims at enriching policy formulation and conduct on matters touching on Science and technology

The research aims at enriching policy so as to effectively address the macro, micro economies and social challenges in Kenya and achieve knowledge-based economic transformation. The knowledge gained will enhance policy development and formulation.

1.7 Theoretical Framework

The study will employ Securitization Theory to comprehend Science and technology and insecurity. In the wisdom of Waever, “Concept securitization is generally associated with the Copenhagen School of Security Studies, generally taken to include Ole Waever, Barry Buzan, Jaap de Wilda and associated researchers. The School originally studied the dynamics of security across five different, nonexclusive sectors military, political, societal, economics and environmental.”⁵⁰It is based on norms, interests and identities of a given social settings.

⁵⁰Waever, Ole (1997a), Concepts of Security. Copenhagen: Institute of Political Science.

Security is one such requirement that brings citizens together and every government has one major function of provision of security to its citizens. Any threat that can affect the livelihood of its nationals must be securitized for the government to deploy all the resources required to counter that insecurity. It argues that certain issues to gain importance and priority have to be securitized. The theory of Securitization as formulated by Ole Weaver state that issues of critical importance to a nation require clear identity and protection. The theory has been crucial among the constructivist studies of international relations and is the basis on which States identify and classify issues of national interest that generate negative consequences to national security. To this end therefore, securitization of science and technology (S&T) threats and cyber threat in Kenya may be important based on the potential threat it poses on the social-economic and political systems and the magnitude of damage resulting there from. This gives the issue more freedom of action than if it was not securitized. The theory implies that Science and Technology because of its importance as enabler and force multiplier in National Security has to be transformed into an issue of National security. The theorists argue on the central notion on state security is to survive. Securitization can be presented as an issue when it is assumed to pose an existential threat to the existence of a referent object. In this regard, the referent object is a state that is perceived to be under danger and require protection. According to Poeples & Vaughan-William, potent that when an issue qualifies to be considered as a security matter, it is politicized and if the danger is magnified, the matter becomes securitized.⁵¹ Example of an issue securitized is the Covid 19 which the government is applying all available resources to counter the scourge.

Consequently, securitization begins from a speech act from political leadership. Abrahamsen argues that securitization is a socially constructed security threat, which becomes represented and recognized as the state proceeds to use whatever means to respond, further supports this

⁵¹Poeples & Vaughan-William 2010:77. *Critical security studies: An introduction*, London:Routledge.

argument.⁵² Similarly, Buzan was quoted in Peoples & Vaughan-Williams adds weight by arguing that the threat, dangers and weaknesses have to be presented as existential threat to referent entity of securitization actors who endorse measures to be taken for instance cyber security. Owing to the increase in globalization and technology innovations has emerged as a threat in the cyber space domain, which has had a substantial influence on state security.⁵³

The increase and sophistication of cyber-attacks and other technologically aided crimes is arguably a prominent non-traditional issue in the national security agenda.⁵⁴ The potential for cyber-attacks against a state critical infrastructure should therefore justify securitization of science and technology. Kenya has lately been a victim of international cybercrime with the most recent one in 2019 involving criminals from China, America and Europe.⁵⁵ The bank frauds in Central Bank of Kenya in 2018, Safaricom hacking in October 2019 and other software related crime on ATMs are just but a few examples of Science and Technology related crimes. Science and Technology has been used in countering the frauds and other crimes. This study notes that cyber-incidents in Kenya have caused significant damage. As much as the potential for catastrophic cyber-attacks against critical infrastructures seems likely, hence cyber-security and other technologically aided crimes/attacks ought to be regarded as a national security issue.⁵⁶ The Government has increased the application of ICT in most of its business interactions, which makes it a likely target for attack. These include e government, internet, data storage and others. Since the youths are the major users of the technology, they are likely to be penetrated because of lack of security awareness in the industry. This gap must be closed

⁵² Abrahamsen 2005:57-58. Blair Africa: The politics of securitization and fera, *Alternative global local political* 30:55-80.

⁵³ Kharouni, L. 2013. "Africa: A New Safe Harbor for Cybercriminals?" Trend Micro Incorporated Research Paper. Available www.trendmicro.co.uk/media/misc/africa-new-safe-harbor-for-cybercriminals-en.pdf. Accessed on 30 March, 2018

⁵⁴ World Economic Forum (2015), "Partnering for Cyber Resilience. Towards the Quantification of Cyber Threats, in collaboration with Deloitte, 2015. P.9

⁵⁵ Angence France Press. 2014 "Kenya Arrests 77 Chinese National in Cybercrime raids: The Guardian, December 5, 2014. Available www.theguardian.com/world/2014. Accessed 02 May, 2018

⁵⁶ Nzwili, F. 2015. "China Kenya at odds over suspected Chinese Cybercriminals." The Christian Science Monitor. Available at www.csmonitor.com/World/Africa/2015. Accessed 08 September, 2018.

by deploying resources on research and development on cyber security. At present, there is a general feeling that knowledge and information on cyber security matters in Kenya and Africa are lacking. In this regard, the securitization theory is most applicable in this study because the threat is existential and requires urgent action by the government, (Hansen & Nissenhaun, 2009).⁵⁷

1.8 Hypotheses of the Study

- i It is assumed that there is an upsurge in security threats in Africa
- ii Science and technology has no role in National security of Kenya
- iii. The policy framework is lacking for National security in Kenya

1.9 Research Methodology

This section explored the methods of the study in responding to the research objective, the study sample and instruments of the study.

1.9.1 Research Design

The study will employ both qualitative and quantitative data. The study shall adopt the research design of a survey of various Information Communication Technology departments at the Ministry of Defence and secondary data collection from the available literature. Surveys will deal with describing, recording, interpretation and analysing of conditions that either exist or existed. It will not engage in manipulation of the variables or arrangement of events to happen.. Surveys will generally be concerned with the present, but they may pay attention to past events to explain how the present conditions are influenced by past events, consequently, surveys will be well suited for social and behavioural sciences⁵⁸. From the definition above, the survey

⁵⁷ Hansen,L. & Nissenhaum, H., 2009. Digital Disaster. Cyber Security and Copenhagen School. International Studies Quarterly, Volume 4, pp. 1-25.

⁵⁸ibid

design is suitable for the current study on how science and technology can be used in advancing security in Africa, a case study of Kenya in 21st century.

1.9.2 Validity and Reliability

Validity refers to the ability of the research findings to reflect accurately the presence or absence of the concept that is being investigated in the study. On the other hand, reliability refers to the consistence of the research findings over time and place. The measure of reliability indicates whether if the study were to be replicated by an independent researcher applying similar methodology would obtain similar results.⁵⁹ This will be was proven through comparison of various literatures on Security, science and technology. Science and technology must apply positively in addressing every component in insecurity.

1.9.3 Sampling

This study targets a population size of 75 people drawn from the following organizations who include professionals and technical staff in IT. These organizations include Ministry of Foreign Affairs, Kenya ICT Authority, Communication Authority of Kenya, National Intelligence Services, the Ministry of Defence, National Police Service, Kenya Revenue Authority, ICT Business Organizations, Banking Sector, Safaricom and Universities. I will utilize stratified sample method targeting IT professionals who include executives, senior managers, junior managers and senior technical staff. This group is chosen because of the quality of information that was required for my research.

Denzin and Lincoln, agree that this type of judgemental sample can only be applied when the researcher is certain on which type of people or units are typical of the population in question.⁶⁰

In this regard, the population chosen to participate in the study will be drawn from the

⁵⁹Mugenda O. and Mugenda G. (1999) *Research Methods: Quantitative and Qualitative Approaches*, (pp 74- 76) Nairobi: Acts Press.

⁶⁰ Norman, K., Denzin, Y and Yvonna, L. *The SAGE Handbook of Qualitative Research*, (2000), pp. 105-117.

institution head offices in Nairobi. The sample chosen in this regard will be a representative of the population sample that can be studied to represent the entire unit of the population.⁶¹

1.9.4 Sample Size

The sample is to be guided by Taylor's guidelines that "a sample should be neither too large nor small as the earlier wastes resources unnecessarily and the later limits the generalisation of study findings".

1.9.5 Sampling Methods

The researcher will adopt the stratified random sampling method in selecting participants in this study.⁶² This kind of sampling method divides the targeted respondents into units, departments and functional areas. The researcher in this study will apply this method of sampling so as to ensure that all different units are well represented in the study.

1.9.6 Data Collection

The research will be based on quantitative research methods. The one on one interview is used so as to obtain facts and minimize prejudices. Purposive sampling will also be used to produce maximum variation within a sample, the respondents are to be chosen based on their work in Science and Technology and Security studies. The information obtained through questionnaire is to assist in the interview with the ICT professionals and technical staff. The interviews will provide valuable information for the study.

A pilot collection and analysis of the interview guide will be conducted to gauge the outcome and correspondence to the purpose of the study. Further, the study will take steps to make sure that the research is done to the required standards according to the University guidelines. The analysis of the data will incorporate the coding of the study content into similar themes based on focus groups interviewed, later analysed using content analysis, and inferential statistics. The content analysis

⁶¹ Ibid, (2000), p. 121.

⁶² Holloway, P. and Galvin, L. (2016), Sampling techniques p. 9.

of the research is a method used to make valuable inferences by coding, interpreting, and textual materials to make meaning to the study.

1.9.7 Data Analysis Techniques

The data will be collected through questionnaires, guided interviews, library and internet sources will be analysed through descriptive statistics and inferential calculations. The data will be presented through charts, narratives, use of graphs and tables. This study will use interpretive content analysis and inferential statistics in analysing the research findings. Denzin and Lincoln, potent that the analysis involves a methodical classification of relevant material from the sample thus permitting application of detailed analysis in this study⁶³. The method of analysing the documents will involve coding of the content into themes according to similar focus groups and later analysing the transcripts. A rubric (the Science and technology and insecurity variables under study) is to be used to grade or score a document. From the interpretation, the research will be able to draw interpretations about the problem and made recommendations accordingly.

1.10.1 Chapter 2: Emerging Security Threats in Africa

Chapter 2 articulates on matters of emerging security threats in Africa among them militia factions and armed gangs.

1.10.2 Chapter 3: Role of Science, Technology and Innovation in Kenya's National Security

Chapter 3 illustrates application of science and technology is necessary to address the challenge of national security in Kenya.

⁶³Norman, K., Denzin, Y and Yvonna, L. *The SAGE Handbook of Qualitative Research*, (2000), pp. 105-117.

1.10.3 Chapter 4: Harnessing Science Technology and Innovation for Kenya's National Security. Chapter 4 sought to examine the options of harnessing science technology and innovation in national security in Kenya.

1.10.4 Chapter 5: Summary, Conclusion and Recommendations

This chapter sums up the acts as the final and ultimate verdict on the issues addressed in the research.

CHAPTER TWO

EMERGING SECURITY THREATS IN AFRICA

2.1 The Narrative of Security Threats, Conflicts and Disputes

The chapter covers the background of the emerging security threats in Africa. There are as different and various histories, geographical settings and cultures as there are many countries in African continent. Most of these countries are in different economic developmental, public policy, internal and international relations stages. In making analysis and reviews of conflicts, their sources and solutions in this continent and its context, security threats will mostly be narrowed down to individual countries as situations in different countries vary.

2.2 Weak States and Terrorism

To arrive at the conclusion of what a weak state looks like, more often, that country must be ill equipped in dealing with differences in culture and identity.

Jackson opines that,

“Differences in culture, ideology and ethnicity, which make up tribal/ethnic boundaries found within the state, may not be easily reconciled with the state itself and this can be ramified across boundaries and across regions. Such issues may spill over into neighbouring states, which share ethnicities and identities. Insecurity in Africa is caused by a multiplicity of factors such as: arbitrary borders created by the colonial powers cutting across communities, heterogeneous ethnic composition of African states, inept political leadership, migrations, corruption, and negative effect of external debt burden, poverty and famine.”⁶⁴

The continent of Africa is rich in natural resources. The continent also has a lot of potential for investment, growth and opportunity. However, according to Paul, “the two emerging trends of liberal democracy and economic prosperity elude this region due in large part to persistent

⁶⁴ Jackson, Burke and Frank Dukes. *Conflict: Readings to Management and Resolution*, London: Macmillan Press Ltd, (1990), p. 16.

skirmishes, conflict and complex socio-political dynamics. The causes are deep rooted in the peculiar effects of colonialism and the cold war supremacy had on Sub-Saharan Africa.”⁶⁵He further argues that, policies formulated in most African countries during these eras of colonialism encouraged environment of nepotism, corruption, scarcity and violent competition.

In the wisdom of Weede, “Emerging conflicts are manifold and complex, deep rooted in international and national arenas, encompassing socio political, cultural, economic, and social parameters and some of the international factors are the consequences derived from the end of the Cold War and its aftermath, globalization and liberalization of the world economy. These have generated a sense of political and economic insecurity in Africa.”⁶⁶

In Africa, it is the internal factors that influence intrastate conflicts. African data analysis indicate that there a huge number of non-economic causes of conflict and alsoa significance of economic factors.⁶⁷Economic causes of problems include; African vulnerability to the changes in external conditions and hostile international economic environment that is biased. For the external conditions includes, exploitation of natural resources, terms of trade and external debt burden. These among many, leads to poverty, food insecurity and economic inequities/poor performance.

On socio-political and cultural aspect, conflicts in the African continent are linked directly to heterogeneous situations of most of the communities. By the time most African countries achieved independence, they had their indigenou multi-ethnic composition which was not a factor for border demarcation.⁶⁸The perceived political exclusion for personal reasons, ethnic or

⁶⁵ Collier, Paul and Hans, Burton. *Ethnic loyalties, state formation and conflict. A background paper prepared for the Africa in the 21st Century Project*. Washington, D.C., World Bank, (1999), p. 91.

⁶⁶ Stedman, S. (2006), ‘*Conflict and Conciliation in Sub-Saharan Africa*’, The International Dimensions of Internal Conflict. Cambridge, MA: MIT Press, pp. 235–65.

⁶⁷ Weede, E. (2001). ‘*Income Inequality, Average Income, and Domestic Violence*’, Journal of Conflict Resolution 25 (4): pp. 639-654.

⁶⁸Jennifer, De M. (2006). ‘*Managing Civil Wars, An Evaluation of Conflict-prevention Strategies in Africa*, [online]. 168(3): pp. 131-144.

value variations “resulted to lack of socio-political unity, lack of genuine access to national institutions of governance, reliance on centralized and highly personalized form of governance, perception of inequality and discrimination and this constitutes major socio-political and cultural causes of conflicts in Africa.”⁶⁹ Whereas most causes tend to be naturally historical, the challenges are promoted by the leadership inequality and lack of better political alternatives.

Western nations colonized Africa and partitioned it between themselves extensively from 18th Century to mid-20th Century. In 1884, Berlin convened a conference for formulating guidelines for partitioning of Africa.

The consequences of the colonialist policies differ widely around the world. Seth Kaplan observes, that, “some former colonies such as Ghana, Botswana, Chile, and Costa Rica had colonial demarcated borders that left them relatively homogeneous.”⁷⁰ Seth further points out that, “these states developed strong national identities, common values, stability, and a comprehensive measure of prosperity”. Rodney Walter observes, that, “independence came abruptly and unexpected to African states and with little experience in modern self-governance and failure to learn from colonialists, democracy failed to take root and instead, influential figures those relatively educated and exposed assumed or seized power and implemented measures to retain power rather than establish good governance. “For instance Angola is a country that appears to have abruptly gained independence from Portugal in 1975. Rodney Walter further opines that “Shortly thereafter, a long-lasting civil war broke out, causing the deaths and displacements of hundreds of thousands This civil war caused the Movement for the Liberation of Angola (MPLA), the ruling faction in Angola, to devote the next three decades to

⁶⁹Dahlman, Carl and Anuja, Utz. *India and the Knowledge Economy: Leveraging Strengths and Opportunities*, World Bank, Washington, D.C, (2005), pp. 12-13.

⁷⁰ Seth K., (2008). *Fixing Fragile States*, Policy Review no. 152, ProQuest, p. 67.

retaining centralized political command and control while neglecting to develop other branches of the government.”⁷¹

Morrison and Hugh argue that, “the role of ethnic multiplicity in intra-state conflicts is widely debated and concluded that cohesion must be built by the political system and one must note the paradox that while an African continental identity both in physical and conceptual dimensions is clearly accepted and expounded by all Africans, the achievement of Africanism identity has been more difficult to achieve.”⁷²

It is important to note and acknowledge that eight out of ten of most poor nations in the world, have and continues to suffer major conflicts and security related challenges. Wars and conflicts in third world countries have huge social-economic effects on the citizens and are the major causes of poverty and underdevelopment. “The extra infant mortality caused by the war in Cambodia, for example, was approximated at about 3 per cent of the country's 1990 total population.”⁷³The currently experienced conflicts experienced in Southern Sudan and Congo are intra states although there are often considerable outside external interference. In the past 30 years, most Africa has experienced war and conflicts.

Jaggers and Ted argue that, “Africa has consistently suffered from the problem of inept and poor leadership that has retarded an all-inclusive political integration and unity in almost all African states, leading to conflict and given the various ethnic and heterogeneous composition of most African communities and states, perhaps what they needed most are the virtues of

⁷¹ Rodney, W., (2001). *How Europe Underdeveloped Africa*. Washington, DC: Howard University Press, pp. 71-79.

⁷² Morrison, D., and Hugh S., (2001). ‘*Political Instability in Independent Black Africa: More Dimensions of Conflict Behaviour within Nations*’, *Journal of Conflict Resolution* 15 (3): pp. 347-368.

⁷³ *Ibid*, (2001), pp. 3-4.

leadership, administrative tact, political tolerance and social justice. These crucial and essential ingredients are to be provided by the continent's leadership.”⁷⁴

Jennifer brings in a new argument that intrastate conflicts originate and emerge for a complex variety of reasons. “At a theoretical consideration, social change of some sort evolves and leads to the emergence of disagreements conflict”. However, conflict is not necessarily a negative phenomenon as is a result of social interactions; what is crucial is how the larger community observes and reacts to the emerging conflict.⁷⁵ The society is defined by dominant or coercive relationships and interactions. This results to structural conflict that emerge likelihood.

According to Agger, combination of societal capacity, conflict triggers and salience factors determines the result of the social change and emerging conflicts. “If the State has the capacity to manage and mitigate the conflict, then a situation of community cooperation amidst latent tension can arise. The societal capacity should be great and ability for conflict management can lead to conflict transformation and regulation, then an environment of peace is possible. However, should States capacity be inadequate to at least manage and mitigate the conflict and various conflict triggers are enhanced, then violent conflict will materialize.”⁷⁶ Conflict triggers are those characteristics that escalate the conflict, resulting in the descent into violent conflict.

Lederach argues that, “conflict triggers are flaming context specific and an accurate understanding of any violent conflict must be preceded by a comprehensive conflict analysis and understanding of the given conflict. Nevertheless, there are several primary characteristics contributing to the outbreak of intrastate conflict that are common in most cases.”⁷⁷ Lederach

⁷⁴ Jagers, K. and Ted G., (1995). ‘Tracking Democracy's Third Wave with the Polity III Data’, Journal of Peace Research 32 (4): pp. 469–82.

⁷⁵ Jennifer M., (2000), *States of conflict: Gender violence and resistance*. London: Red, p. 43.

⁷⁶ Agger, I., (1994), *The blue room: Trauma and testimony among refugee women*. London: Zed, p. 6.

⁷⁷ Lederach, P. J., (1999), *Building peace-sustainable reconciliation in divided societies*. Tokyo: United Nations University Press, pp. 101-103.

further notes that “as the nature of conflict has changed from interstate to intrastate, so too has its impact on human life”.

Bertram is of the opinion that, “one of the major factors responsible for internal conflicts in Africa are the devastating impact of corruption and leadership. Corruption, manifested in the embezzlement and misappropriation of public funds by the leaders, has paralyzed infrastructure development efforts and caused weak states immobilized in the march towards take off socio-economic transformation and political integration in the continent of Africa.”⁷⁸ The study notes that Africa’s resources being plenty have been badly utilized over the years to the point that masses have lost patience and are fed up with their leaders and their leadership styles. This has given birth to militant nationalism against Africa leaders, and as consequence unending intra state conflicts.

Arguably, Africa is the “poorest continents of the world”. Scholars largely attribute this mainly to corruption, severe environmental conditions and enormous unsustainable external debts that catalyse the conditions of poverty. Anwarul argues that, “unlike developed nations, land is the most important factor of production to most Africans for food security and survival. Consequently, land ownership, distribution disputes, land tenure systems and property rights are factors in many African conflicts.”⁷⁹ Warring factions seize land to gain access to minerals and cash crops. This does not only lead to intra state conflict but there are neighbouring countries that have invaded to exploit natural resources.

This study illustrates that the impact of technology to the earth (environment) can be depicted by its physical appearance. For instance, in the Kenyan context technology has been used in

⁷⁸ Bertram, E., (1995). *Reinventing government: The promise of and perils of United Nations Peace Building*. Journal of Conflict Resolution 39, UN3, pp. 387-418.

⁷⁹ Anwarul, K., (2005), *The role of women in world peace and the role of men and boys in gender equity*. Women’s Studies Review, pp. 30-33.

production of draught resistant high yielding crops. The mechanization in large-scale farming and irrigation is experienced.

2.3 Evolution of African National Security Challenges

In the opinion of Paul, Williams, “the continent continues to hold the attention of many strategic thinkers and commentators, leaders, scholars, policy makers and citizens as one of the most conflicted and unstable regions of the world.”⁸⁰ Swatuk Larry opines that, “the Great lakes region and the Horn of Africa have rightly been termed one of Africa’s hotspots and epicentre in reference to peace and security challenges while regions, comprising of Djibouti, Eritrea, Ethiopia, Kenya, Somalia, South Sudan, Sudan, Tanzania and Uganda has witnessed conflicts ranging from inter states, secessionist wars, intra-state violent conflicts, foreign interventions, terrorist attacks and piracy, as well as post-election violence.”⁸¹

Conflict is socially constructed and as a phenomenon, is widely perceived to be part of daily pattern of life. Moreover, by widening and broadening the understanding of security beyond physical violence, “state-centric and its military dimension, the region has seen human security challenges arising from the spread of refugee flows, small arms, droughts and environmental degradation as well as humanitarian crises, which all affected the region as a whole.”⁸² The numerous security challenges from globalisation straddling national borders hence require policy responses that equally take a regional rather than a national perspective.

Kenya’s national security, stability and economy have experienced destabilization due to series of terror attacks, which started with Norfolk hotel in 1980. The recent attacks target some important targets in the country by Al-Shabaab. Previously the group also kidnapped Tourists and aid workers from Kenya into Somalia. In response to these security threats, Kenya decided

⁸⁰Paul, Williams. Thinking about security in Africa, *International Affairs*, 83:6, (2007), p.1022.

⁸¹Swatuk, Larry A. and Dianne Rahm. Integrating policy, disintegrating practice: water resources management in Botswana. *Physics and Chemistry of the Earth*, Vol. 29, (2004), pp.1357–1364.

⁸²Hagmann, Tobias (2005) “Confronting the concept of environmentally induced conflict”, *Peace, Conflict and Development*, issue 6, Jan 2005.

to pursue and protect its national security by military means.⁸³ The Kenya Defence Forces (KDF) entered Somalia in 2011 in and fought with Al-Shabaab, pushing the terrorist group into Somalia. The Kenyan force was later transformed into AMISOM peacekeeping mission under the mandate of AU and UN. There are also over 22000 other African troops in Somalia mandated by the UNSC and African Union (AU) to support Somalia's National Army fight against Al-Shabaab.

Rajamani Lavanya states that, "AMISOM and the Somali national army are engaged in wars with Al-Shabaab and have dislodged them from many parts of the country; the group is still active, transforming itself, acquiring new capabilities and poses eminent threats against neighbouring states, sub states, regional and international security. Ethiopian, Kenyan and Uganda national security are concerned about possible attacks from groups in Somalia."⁸⁴ He further points out that an increased support from international community for Somalia's government to fight the militant groups has been forthcoming but the threat still remains.

Rajamani Lavanya observes that, "the African Union Mission in Somalia (AMISOM) is an active peacekeeping mission by the African Union with the approval and support of the United Nations. It is mandated to support transitional governmental institutional structures, implement a comprehensive national security plan, train the Somali security forces, and intervene in creating a secure environment for the delivery of humanitarian aid".⁸⁵

According to AMISOM press release, "The African Union's Peace and Security Council proposed AMISOM with an initial six-month mandate on 19 January 2007. On 21 February 2007, the United Nations Security Council approved the AMISOM's mandate. The United

⁸³Rajamani Lavanya. *Ambition and differentiation in the 2015 Paris Agreement: Interpretative possibilities and underlying politics*. *International and Comparative Law Quarterly*. 65(2016), pp. 493–514.

⁸⁴Rajamani Lavanya. *Ambition and differentiation in the 2015 Paris Agreement: Interpretative possibilities and underlying politics*. *International and Comparative Law Quarterly*. 65(2016), pp. 493–514.

⁸⁵ Eriksson, Mikael. *Somalia's Civil War, Security Promotion and National Interest*. Swedish Defense Research Agency FOI-R--3718—SE. ISSN 1650-1942. *Mainstay of defense*, (2013), p. 13.

Nations Security Council has also authorized thereafter-subsequent six-monthly renewals of AMISOM's mandates as recommended by the African Union Peace and Security Council. In August 2014, the Somali National Army assisted by AMISOM launched Operation Indian Ocean to clean up the remaining Al-Shabaab-held pockets in the countryside. Operation Indian Ocean was a joint military operation between the Somali Army and AMISOM with technical assistance from the United States military. The operation took place in southern Somalia from August 2014.”⁸⁶

The Horn of Africa faces other challenges on the horizon; Kenya's government faces a large number of refugees and wishes to shut down the numerous refugee camps in its country. The camps house hundreds of thousands of people, many of whom fled Somalia. Last Kenyan government closed most of the camps and together with international Red Cross started repatriating the refugee. The concern was that these camps could harbor Al-Shabaab militants. The undertaking almost certainly strained aid supplies for humanitarian crisis, but with government assistance, this was facilitated.⁸⁷

Kalinaki argues that “whether looked from the perspective of state, intra-state and inter-state conflicts, insecurity in the Horn has its roots in its historical complexity, political economy, state formation processes, colonialism and struggles, international intervention, identity transforming conflicts and environmental change.”⁸⁸ Paul on the other hand further says that, “The Horn of Africa illustrates a paradox; many numerous regional actors are committed to peace support operations but the region remains the most conflict-torn of the continent”.⁸⁹ Most of the states of the Horn of Africa are in either conflict or major crisis.⁹⁰ The intra and inter-state conflicts in the Horn of Africa are intimately transformed and connected. Intra-state conflicts very easily

⁸⁶ AMISOM press release, 25 November 2012, ‘AMISOM Force Commander Tours Hiraan Region.

⁸⁷ AMISOM 2016, ‘AMISOM's new Force Commander formally assumes office’, press release, 19 July 2016.

⁸⁸ Kalinaki, Daniel. *How Shortage of Equipment, Poor Operation Flaws Cost Amison 19 Soldiers*, The Monitor, Kampala, (2016), p. 39.

⁸⁹ Paul Williams, ‘Thinking about security in Africa’, *International Affairs*, 83:6, (2007), p.1022.

⁹⁰ Woodward, Peter. *Crisis in the horn of Africa*, Published, London, (2013).

spill over across international boundaries triggering conflict in other states and resulting in inter-state conflicts. Inter-state conflicts also tend to drag other nations into the conflict either directly or indirectly. However, Inter-state conflicts have been steadily waning, while intra-state conflicts have taken root.⁹¹

Tadesse narrates how armed conflict has had massive effects across much of the Horn of Africa for decades:

Sudan for example, has experienced a combination of civil war and governance core periphery conflicts since independence. Somalia descended into complex civil war after overthrow of Said Barre in the early 1990s from which it has yet to recover. After a long armed struggle, Eritrea won secession independence from Ethiopia in the 1990s. A major interstate border conflict erupted between Ethiopia and Eritrea from 1998 to 2000, lead to war and the ceasefire remains fragile.⁹²

Maritime security is the reason why nation-states for centuries have developed naval forces.⁹³ Thus, maritime interests that include the controls of seas, maritime resources, tourism and trade are necessary to defend and might require naval power assertion in order to protect the nation-state and its maritime assets.

Goldie argues that “maritime security it is a term that draws attention to new challenges and rallies support for tackling these issues, notwithstanding to date no universal definition of maritime security has ever emerged either from Law of the sea (UNCLOS) or International Maritime Organization (IMO)”.

⁹¹ Degu, Wondem. *The State, the Crisis of State Institutions, and Refugee Migration in the Horn of Africa* (Lawrenceville), (2007), p.1022.

⁹²Tadesse, Medhane. *Traditional Mechanisms of Conflict Resolution versus State Intervention. The Borana Oromo and Merihan Somalis in Ethiopia, Transformation of resource conflicts: approach and instruments.* Bern: Peter Lang, (2002), p. 13-16.

⁹³Rodrigue, J.P. *Ports and Maritime Trade in Barney Warf.* *Encyclopedia of Human Geography*, London: Sage, (2010), p. 13.

Goldie further clarifies that African nation-states as littoral have major stakes in the blue economy and significant maritime security problems.⁹⁴

2.4 Cyber Security and Globalisation

The developed countries have experienced various forms of security challenges that have had effects on their economies, social and political emanating from technology aided terrorism, cyber-attacks, piracy, money laundering, hijacking and others. In the attempt to safeguard themselves and secure environment, states have invested and acquired the most advanced defense technology in form of hardware and software for their armed forces. Burke, Jackson and Dukes, Frank sees technology as “the process of using certain information necessary to achieve a certain production outcome from a particular innovative means of combining or processing selected inputs” they maintain that many technologies will generate the same outcome but they may differ in terms of means and their efficiency.⁹⁵

Burke, Jackson and Dukes, Frank further points out that “technology may be quite specific or general. It may encompass several sub-processes, such as producing intermediate by-products or inputs within an overall value chain and technologies may be particular production, product, processes, intra-firm organizational structures, management techniques, financial saving, cheaper marketing methods, or any combination of these.”⁹⁶

Need for better and precise defence industrial technology has become a key element in economic development of many countries in the world. Economic is an enabler in Military. Over the years, various science, technologies, and innovations have taken place in the global scene with defence technology as the most exciting and celebrated. The contemporary world is faced with the most advanced and rapidly changing market conditions characterized by

⁹⁴ Goldie, A.J. Africa. A Modern History. London, (2006), pp. 660-663.

⁹⁵ Burke, Jackson and Dukes, Frank. *Conflict: Readings to Management and Resolution*, London: Macmillan Press Ltd, (1990), p. 16.

⁹⁶ Burke, Jackson and Dukes, Frank. *Conflict: Readings to Management and Resolution*, London: Macmillan Press Ltd, (1990), p. 16.

cooperation and competition.⁹⁷ This has resulted in advanced global defense industry dominated by various large defense investors mostly from America, Europe and Asia.

African Union Agenda 2063, aspirations envisage an era of peace, an end to all inter, and intra national conflicts including silencing of all guns on the continent. It forecasts that African states will consider building a capable collective defence industry for the overall comprehensive defence capability and national defence strategy.⁹⁸

Lack of security in Africa is caused by a multiple of factors such as: arbitrary porous borders, heterogeneous ethnic communities, poor political leadership, corruption, unmanageable external debt burden and poverty.⁹⁹ Africa is a vast land rich in various natural resources with great potential for industrial production, investment and opportunity. However, democracy and economic prosperity elude this continent largely due to perennial conflict and cultural, socio-political problems.¹⁰⁰

Stedman observes that, “insecurity is manifold and complex, influence by in international and national arenas, and encompassed by social economic, political and cultural parameters and among the international factors, are the effects derived from the end of the Cold War and its aftermath, as well as the globalization, terrorism and liberalization of the world economy. This has generated a sense of political and economic insecurity in Africa.”¹⁰¹ Erich states that, “internal factors have been important factors in influencing and igniting intra-state conflicts

⁹⁷ Global Defense Perspectives. Mapping Prioritization and Posture in a Challenging World PwC, (2015), p. 89.

⁹⁸ Defence Review, Chapter 15, (2015), pp. 111-16.

⁹⁹ Burke, Jackson and Dukes, Frank. *Conflict: Readings to Management and Resolution*, London: Macmillan Press Ltd, (1990), p. 16.

¹⁰⁰ Collier, Paul and Hoeffler, Hans. *Ethnic loyalties, state formation and conflict. A background paper prepared for the Africa in the 21st Century Project*. Washington, D.C., World Bank, (1999), p. 91.

¹⁰¹ Stedman, Schraeder. *Conflict and Conciliation in Sub-Saharan Africa, The International Dimensions of Internal Conflict*. Cambridge, MA: MIT Press, (2006), pp. 235–65.

and analysis of conflict from many African countries, points to a number of non-economic and economic factors.”¹⁰²

On non-economic side, at the most basic level, insecurity in Africa is externally acquired and related to the way human inequality and capitalism was enshrined after independence by African countries. Governance did not reflect multi-ethnic composition of the independent states.¹⁰³

Jennifer states further that,“exclusion from the political process and decision making for reasons of personal, ethnic cohesion or value differences, lack of socio-political unity, and lack of genuine access to national institutions of governance on discrimination, reliance on centralized and highly personalized form of governance” and that the “perception of inequality and discrimination on resources and development, constitute major socio-political causes of conflicts in Africa”.¹⁰⁴

Knake argues that,“the new form of warfare is more of asymmetrical than conventional in nature where there is no precision target. The adversaries wage cyber warfare without need for expensive fighter jets, warships or aircraft carriers but only low cost of computing software devises, to pose a significant threat to the government’s performance capabilities.”¹⁰⁵

Lately, economic liberation, globalization and explosive growth of information telecommunication-Technology (ICT) has dominated the political, corporate and business agenda that is defining a new paradigm shift where competition and cooperation must coexist amongst most pragmatic societies and nations. Cooperation in security enhances sharing of information. This will call for tactful and skilful diplomatic manoeuvring of different security

¹⁰² Weede, Erich. *Income Inequality, Average Income, and Domestic Violence*, Journal of Conflict Resolution 25 (2001): pp. 639–654.

¹⁰³ Jennifer, De M. *Managing Civil Wars, An Evaluation of Conflict-prevention Strategies in Africa*, (2006), pp. 131-144.

¹⁰⁴ Ibid, (2006), pp. 131-144.

¹⁰⁵ Clarke, Knake. *Cyber War: The Next Threat to National Security and What to Do about It*, (2010), p. 140.

priorities in future that will be based on sound understanding of the role of Science and Technology (S&T) in international security affairs.¹⁰⁶

Jannifer identifies two of the major barriers to technological transfers at federal laboratories: “the other one does not always share the expectations of one party because mainly is commercially driven. Secondly, there often exists a lack of full awareness of the total value of the existing technology being transferred.”¹⁰⁷

Athina found that the interconnectedness of S&T with foreign and diplomacy policy are age old, but have never been more important and emphasized than in the globalised, multi-polar world of today. Most defining challenges of the 21st century, from basic human insecurity to the concerns of global climatic change, from satellite security of outer space to security in cyber space, all have scientific, technological and innovation dimensions.¹⁰⁸ These have global interconnection and no one country will be able to solve these security related problems on its own. The instruments, techniques and formulations of foreign policy of nations need to adapt to this transforming world of scientific and technical complexity that has been made simple.

Susannah defines technology transfer as “the process of sharing, transmitting, or conveying technology, data, and information including intellectual property between government agencies, archives, industry, and academia.”¹⁰⁹ The broad goal of this in security process is to identify exemplar practices for technology transfer recommended by Departments of Defense, laboratory staff, Research and Technology Applications, legal staff and other stakeholders. The

¹⁰⁶Cheldelin, Sandra and Eliatamby, Maneshka. *Women waging war and peace: international perspectives on women's roles in conflict and post-conflict reconstruction*. London and New York: Continuum, (2011), p. 305.

¹⁰⁷ Jennifer, De M. *Managing Civil Wars, An Evaluation of Conflict-prevention Strategies in Africa*, (2006), pp. 131-144.

¹⁰⁸Karatzogianni, Athina. *Violence and war in culture and the media: five disciplinary lenses*. London and New York: Routledge, (2012), pp. 280-281.

¹⁰⁹ Howieson, Susannah. *Institute for Defense Analyses 4850 Mark Center Drive, Alexandria, Virginia*, (2013), pp. 845-2000.

purpose is to inform all security personnel about these practices and encourage their adoption across the security sector.¹¹⁰

Government represents a security challenge issue for the field of security studies. In order to study the war on terrorism, or other emerging security phenomena, strategic studies on security must, also involve in some sense analytical studies in the process of governance.¹¹¹ Insecurity in Kenya is caused by both direct and indirect socio-economic, political factors and historical inhibits access to security services. The main cause of insecurity revolve around perceptions and realities of marginalization, relative deprivation, politics, ethnicity, nepotism, corruption and poor governance. These causes/drivers are also motivated and enhanced by the country's political social constructivism on which has since independence has leaned towards the preservation and protection of the regime and preservation of the status quo and political elites. Insecurity in Kenya has arisen despite the constitutional reforms of 2010 that have took place to address and prevent violence in Kenya in the post-election violence of 2007-2008. Kenya experiences multiple, extensive and overlapping conflicts, which sometimes coincide with electoral cycles that act as triggers for ethnic and politically motivated violence.

In Kenya today, defence technology applications influence the society through the functions such as food health, military, shelter, transportation, climate control, communication and computation. Accelerating pace of technology improvement and development is crucial because it has brought efficiency and enhanced capability to a large numbers of people worldwide. The increasing availability of information communication technology and the growth of communication networks have been major factors in the globalization of the 21st century.

It is important to note that Science and Technology (S&T) has its own unique challenges. Some of challenges in the Kenyan context include cybercrime. Cybercrime is mainly through hacking,

¹¹⁰ Ibid, (2013), p. 2001.

¹¹¹ Hagelin, Björn. *Science- and Technology-Based Military Innovation in South Africa*, SIPRI Yearbook, Oxford, OUP: (2004), pp. 285-304.

phishing, spamming and intrusion into people's privacy. ICT has heralded the end to privacy and confidentiality as personal dossier is accessed and shared without the persons consent.

2.5 Climate Change, food security and Diseases

It must be acknowledged, that Science and Technology has assisted in the economic improvement of the people's lives in multiple ways. Agriculture, tourism, banking, service industry, business and entrepreneurship among others have undergone transformation and growth. These are element of human security as for the Human Development report by UNDP in 1994. Other innovations and economic based initiatives include ease of digital communications and the liberal regulations in the financial and fiscal sectors. Kenya economic growth is anchored on priority sectors with the aim of raising GDP growth up to 10% per annum. These sectors include tourism, retail and wholesale, livestock and agriculture, manufacturing, finance, business process out sourcing (BPO) and mining. Their efficiency is technology driven and indicated in the Kenya Vision 2030.

Biotechnology, which is part of science and technology, is credited with expansion and improvement of horticulture farming, which has seen better varieties of fruits produced as demonstrated by Makueni County project, which now produces mango juice for export by value addition. The introduction of genetically modified flowers and food items remains a major source of revenue to the country, and a source of employment. Horticultural greenhouse development is going on with the production of perishable green vegetables for both subsistence, local market and export. Technology has also helped in the development of varieties of avocado species which are not only for food security but also export to China.

Kenya just like the rest of the world has undergone great transformation of technological changes. The current trend is dominated by value addition knowledge based industries. The focus on intangible knowledge assets includes research and development, patents, proprietary

technologies, intellectual property, databases and brands. Kenya has made tremendous steps by developing policies and putting in place necessary structures in the field of science and technology geared towards spurring employment, economic growth and development.

2.6 Mitigating measures aimed at addressing emerging Security Threats in Africa

Military science, technology, innovations and engineering capability has become more diffuse. Pandit argues that, “as defense, industrial capability develops and diversifies, government and corporate business leaders will face difficult decisions about which military technologies to invent at home, and which to buy from an increasingly capable outsource.”¹¹²

Nikolai states that “the main source of traditional insecurity in most African countries have to do with unsolvable or unresolved internal ethnic conflicts, power sharing disputes and inequality, greater deal of injustice, lack of rule of law, undemocratic inept governance and weak institutions, internal and border disputes between countries, religious and cultural differences, desertification and poor agricultural reforms.”¹¹³

Dombrowski and other scholars note that, “although Ethiopia began manufacturing weaponry in its cottage industries in the 18th century, its modern scientific defense industry is traced to 1953 with the opening of the then-Emperor Haile Selassie ammunition factory built on scientific and technological transfer from the government of Czechoslovakia. During the Derg Regime, (1974-1991) serious concern was given to the development of a domestic scientific based defense industrial base.”¹¹⁴ With technical support from the Soviet Union and other Eastern Bloc nations several defense factories were established and run.

In Kenya, technologically and scientifically skilled workforce trained to work with modern equipment and production processes “are the pillar on which Kenya’s aspiration will be

¹¹²Rajat, Pandit. Forces battle shortage of ‘fighting rank’ officers, Times of India, (December 1, 2014).

¹¹³Nikolai, Novichkov. Update: Russia to Develop New Defense Plan for 2016 – 2020 by End of the Year, Jane’s Defence Weekly, (2015), p. 98.

¹¹⁴ Ibid, (2002), p. 541.

anchored while utilization of modern capital equipment to produce efficiently value added globally competitive goods and services, as well as the import substitution, and adoption of appropriate knowledge produced either locally or outside the country will be key in enabling Kenya achieve its vision of being industrialized”.

2.5 Conclusion

In the 21st Century, Science and Technology is a vital factor in both traditional and non-traditional aspect and more specifically has a fundamental security implications. It has set the world economy into a competition mode. “Technology transfer” is a subject that cannot be ignored. It is of utmost consideration by many groups among them policymakers, international agencies responsible for funding, corporate business executives, relationship between technology transfer and economic growth. Technology has borne the interest of academic researchers and system developers.

Technology transfer involves among many other activities: carry out maintenance works, learning how to operate machines, implementing minor innovations and minor repairs, and finally at the last stage, the major design and development of new products and manufacturing processes.

CHAPTER THREE

ROLE OF SCIENCE AND TECHNOLOGY IN ADVANCING NATIONAL IN 21st CENTURY

3.1 Science, Technology and Innovation in the Kenya Perspective

This chapter covers the background, the role of science, technology and innovation in advancing National Security in Africa with particular emphasis on Kenya. Science, Research and Development in the Kenya has over the years experienced tremendous growth especially in security, agriculture, natural resources, medical health and ICT sector. Most of the R&D is supported by funds from abroad. Recently, indigenous and exotic innovations in utilization of computer soft and hardware technology and embedded systems has gained dominance in the public domain due to affordability, efficiency and ease of access.

Science and Technology makes growth and development of knowledge relevant and applicable and essential to citizen security, livelihood and critical to developmental objectives at local, national, regional and international levels. A relevant and effective science, technology and innovation systems is vital for a country's harnessing and exploitation of the potentials of its people.¹¹⁵

Obudhpoints out that, "Various opportunities have been made of S&T to meet societal social and economic needs while many manufacturing industries and processes have been born out of science, for example, the nuclear power industries."¹¹⁶ These become less dependent on science, but continue to rely on it for their upgrade, innovation, intergrade and growth. Sustainable economic development requires that a country not only produces primarily raw materials but also adds value to those materials using hi-tech services.

¹¹⁵ Obudho R. A., 1999: In Obudho R. A. (Eds) - Urbanization and Sub-urbanization Processes over Time and Space. Kenya.

¹¹⁶ Ibid.

It was immediately after independence that Kenya adopted Research and development as process enabler. This kicked out in many industries under the East African Community until its breakup in 1977. In the same period, there were extensive innovations, growth and development of science and technology in the country. These processes brought about the need for a coordinated and regulated mechanism in promotion of S&T activities, resulting to the enactment of the Science and Technology regulation Act Cap. 250 of Laws of Kenya in 1977. Mugabe note the following: “The Act aimed at providing guidance and oversight to the development of S&T by ensuring its integration in national, social and economic development. The Sessional Paper No. 1 of 1986 on The Economic Managing for Renewed Growth outlined a number of key areas for which the application and use of S&T is important and there followed the formation of the Ministry of Research, Science and Technology in 1987, to oversee the evolution and development of a sound national science and technology base. Science, Technology and Innovation (ST&I) play a pivotal role in the industrialization, sustainable growth and socio-economic development of nations.”¹¹⁷

The government set goals for S&T as outlined in the 1974-78 National Development Plan for “the acquisition of knowledge, the identification of priority development opportunities and increase of national growth rates.” One of these priorities was Kenya’s Military Industrial Complex. However, it was later observed to be linear and could not effectively serve critical national needs, using experience of India, South Africa, Nigeria and Ethiopia.¹¹⁸ Kenya has a great potential to initiate and develop robust a defence industry that will enhance and support other sectors of the national economy. Based on the existing Kenya Ordnance Factories Corporation (KOFC) at Eldoret, established in 1997 as a manufacturing plant for small arms

¹¹⁷ Mugabe J.. *Centers of Excellence in Science and Technology for Africa’s Sustainable Development. Towards New Forms of Regional and Sub-Regional Networks*. Paper prepared for the African Ministerial Conference on S&T for Development, (2003), p. 89.

¹¹⁸ Munene, Macharia. *African Review of Foreign Policy*. A publication of United States International University, Africa, Nairobi, (2009), p. 51.

and light weapon ammunition. This was a joint effort of the Kenya Army Electrical and Mechanical Engineering (KAEME) technical workshops, Defence Forces Technical College (DEFTECH), Kenya Numerical Machine Corporations (NMC) and other local factories. This illustrates great potentials to establish other capacities.¹¹⁹The recent KDF innovation, development and production of a field kitchens is quite laudable and has presented an opportunity to follow a product from conceptual design, process and to production, thereby learning the critical R&D processes and intellectual property issues. Research and development in KDF is carried out in different formations and units under the policy administrative supervision of Defence HQ R&D branch. The Directorate of MI independently conducts precise R&D in coordination with MI Bn and Kenya Army Corps of Signals technical wings especially on sensors, UAVs, Communications systems, ICT and force protection technology. This arrangement creates a system with effective duplication of efforts, efficient overlap of responsibilities and lack of oversight.

Military Industry Complex can be relied by developing indigenous technology to suit operational requirements and in shaping political economy of African nations. Many African countries have relied heavily on importation of weapons, which are not suitable to the local operational environment.¹²⁰ Such situations can be avoided by adoption of defence technology that will enable operational readiness and reduce on dependence on foreign imports.

3.2 Science and Technology Prospects and Role in advancing National Security

Kenya like many other countries faces many security challenges ranging from runaway theft and destruction of property, robbery, violent extremism, cyber insecurity, terrorism, burglary, murder, cybercrimes, land based and resource conflicts, terrorism, political violence, insurgency by armed militias, maritime piracy, climate change, draught, refugee influx, internal

¹¹⁹ Ibid, (2009), p. 61.

¹²⁰ Fulgence N (2015) War on Terrorism in Africa: A Challenge for Regional Intergration and Cooperation Organizations in Eastern and Western Africa. J Pol Sci Pub Aff S1:007. doi:10.4172/2332-0761.S1-007.

and interethnic armed conflict, cattle rustling, nepotism, corruption, drug and human trafficking among others.

National security policy is not unique to Kenya but is common in most states that operate with structured systems of democratic governance. These states most often develop policies that guide their functions in every sector. In order to explore and examine the determinants of the country's national security policy since independence, it is important to understand and appreciate the historical context of Kenya's policies since independence and the role of the colonial legacy and its effects on post-independent Kenya.¹²¹

It must be appreciated that as a result of the frequent terror attacks, cybercrime related issues and the increasing costs of natural disasters, many countries are opting for 'contingency planning' to help protect their citizenry, assets and facilities. To effectively address security challenges, concerned agencies need to develop metrics by Security measurement of a system in an environment.¹²²

The rapid speed of science and technology developments presents a lot of challenges to security institutions striving to be the hot bed of technology. The private sector players are more active producers of technical knowledge and innovation. This has reduced the security agencies to a mere client whose reliance is more on commercial organizations that are producing and updating new technologies. The steady growth of civilian and commercial industries has also led to competition with defence firms in developing new technologies, except in a few specific defence-related applications.¹²³ However technology hard ware is similar what differs is the software and application. The local demand for defence products usually, is highly dependent

¹²¹ Munene, Macharia. *African Review of Foreign Policy*. A publication of United States International University, Africa, Nairobi, (2009), p. 51.

¹²² Fulgence N (2015) War on Terrorism in Africa: A Challenge for Regional Intergration and Cooperation Organizations in Eastern and Western Africa. *J Pol Sci Pub Aff* S1:007. doi:10.4172/2332-0761.S1-007.

¹²³ Munene, Macharia. *African Review of Foreign Policy*. A publication of United States International University, Africa, Nairobi, (2009), p. 51.

on the country's perception of the threat from its adversaries in the short and the long-term or from within and from outside the country. The economic conditions of the country serve as a constraint or enabler on this demand. Therefore, the requirement for defence industry depends on a country's economy, the stage of technological development of the country and security needs.

In the wisdom of Fulgence:

“In most advanced knowledge societies, the pursuit for security and defence needs goes together with investments in both advanced technological and non-technological R&D (processes, concepts and methods). Defence R&D rationale for small economies is multi-dimensional requirement thereby enabling them to conduct and manage future strategic risks assessment sensibly, To improve military capabilities, contribute to knowledge creation, develop interagency solutions in a comprehensive security framework, conduct ‘smarter’ procurement activities and support the defence industrial base, investment in technology is necessary.”¹²⁴

The evaluation, appreciation and support of the various defence R&D roles and strategic utility by organisations is dependent upon their understanding and consideration of the value created by scientific research, knowledge-oriented culture and their ability to see beyond short-term operational pressures and theatres. Fulgence observes that, “the reliability, relevance, usability and quality of applicable defence R&D solutions serve as the best illustrative arguments for appreciating the function, role and contribution of R&D. The Security sector,

¹²⁴ Fulgence N (2015) War on Terrorism in Africa: A Challenge for Regional Intergration and Cooperation Organizations in Eastern and Western Africa. J Pol Sci Pub Aff S1:007. doi:10.4172/2332-0761.S1-007.

therefore, requires developing security mechanisms to integrate R&D into their policy development and experimentation and a capacity to implement R&D results effectively.”¹²⁵

Kenya has also made major milestones contributions in terms of training and capacity building towards peace and security worldwide. The International Peace Support Training Centre Karen, Kenya which has existed since 2001 was put in place to promote operational capacity for peacekeeping through education, training, research and development for the benefit of military, police, and civilian staff components. The Centre also guides on the role of women in peacekeeping, has done, and hosted many courses on women for military and police officers peacekeepers, and in the protection of civilians and non-combatants. It has further engendered all of its course curricula to address various gender issues in armed conflict, peace support operations and peace enforcement while adhering to the UNSC Resolution on the role, function and participation of women in Peace and Security (UNSCR 1325) and other related resolutions and peace frameworks.¹²⁶

IPSTC provides a training opportunity for Military, Police and Civilian Personnel as a one stop training hub under same roof in a wide range of multi-dimensional perspectives and integrated aspects of Peace Support Operations (PSOs) taking cognizance of the comprehensive, realistic, and reliable training required in emerging security complex peacekeeping environments. The training centre has a model setup village (Amani Village) at Embakasi for live illustrations and demonstrations in Peace Support Operations. The demo village been modernized by incorporating CCTV technology where live streaming of demonstrations of Peace Support Operations modules and training is made possible to a far remote location for trainees in real time.

¹²⁵ Fulgence N (2015) War on Terrorism in Africa: A Challenge for Regional Intergration and Cooperation Organizations in Eastern and Western Africa. *J Pol Sci Pub Aff* S1:007. doi:10.4172/2332-0761.S1-007.

¹²⁶ Munene, Macharia. *African Review of Foreign Policy*. A publication of United States International University, Africa, Nairobi, (2009), p. 51.

Kenya acknowledges the importance of the Triangular Partnership Project (TPP), initiative in enhancing operation performance which comprises of three partner namely; the UN, the Donor country and the Troop Contributing Country who work together to build the operational capacity of African Troop Contributing Countries. TPP are beneficial to Kenya, the region and the International Community.¹²⁷

Fulgence further sees the “Improvised Explosive Devices” (IEDs) as currently “the biggest threat as earlier alluded to Peace Support Operations in Eastern Africa being the destructive weapon of choice for Al Shahab, terrorists and insurgents in asymmetric warfare especially in Somalia. Kenya has established a Counter Improvised Explosive Device training wing at IPSTC to address this challenge” and that “this platform will assist and build capacity of Troops in mission areas in countering the IEDs”. The Training centre provides up to date training on the countering of IEDs through threat assessment and analysis and a vulnerability based knowledge sharing platforms that cut across all levels of operation strategic, operational and tactical levels of command.

3.3 Science and Technology regulations in Kenya

Research and Development in Kenya is regulated by the Science, Technology and Innovation (ST&I) Act of 2013. This Act facilitates the policy, promotion, co-ordination and regulation of the progress of appropriate science, technology and innovation of the country under the Ministry of Information, Communication and Technology. Other Ministries have also been facilitative through education, training and emphasise on E-Government policy. The policy is best implemented in the civil domain due to the research areas addressed.

¹²⁷ Fulgence N (2015) War on Terrorism in Africa: A Challenge for Regional Intergration and Cooperation Organizations in Eastern and Western Africa. J Pol Sci Pub Aff S1:007. doi:10.4172/2332-0761.S1-007.

3.3.1 Economic Recovery Strategy for Wealth and Employment Creation

Security is dependent on economic development hence resource availability, affordability, budget constraints and/or limits or otherwise. The economy as an element of national power that provides a source of power that includes the ability to produce goods and services, a combination of capital, labour, raw materials, and other attributes of the social and economic geography can be a formidable source of securing a nation's security. Economic security can be considered a key indicator as to the general security of states.

“The Economic Recovery Strategy for Wealth and Employment Creation (ERS) 2003-2007”, underscores the importance of ‘Science, Technology and Innovation (ST&I)’ and ‘Technical Education (TE)’ as “one of the key strategies for improving productive systems to achieve the expected results”. On the same basis is the ‘Capacity based Curriculum (CBC)’. These crucial national activities currently taking place in Kenya within the sector of ST&I are widely spread out across various stakeholders, from education sector, governments, civil society, non-governmental organizations, universities, colleges and private institutions.¹²⁸

3.3.2 The Medium Term Expenditure Framework (MTEF)

According to the Republic Of Kenya Sector Plan for Science, various sub-sectors of the Economy contribute significantly to the National Gross Domestic Product (GDP). “Agriculture contributes about 24 percent to the GDP and accounts for over 60 per cent of total export earnings. It further accounts for approximate 65 per cent of Kenya's total exports, 18 per cent, and 60 per cent of the formal and total employment respectively. During this second medium Term Plan (MTP 2015-2020), agriculture has grown at an average of 4.3 per cent.”¹²⁹

¹²⁸ World Bank. *World Development Report 2009: Knowledge for Development*. New York: Oxford University Press, (2009), p. 97.

¹²⁹ Republic Of Kenya, Sector Plan for Science, Technology and Innovation 2013-2017.

Research and Development institutions in the sector of agriculture play a critical role in strategic research. They disseminate current technologies, information and knowledge aimed at increasing productivity and competitiveness in the sector. They come up with high yielding varieties of crops and domestic animals. The sector also has a number of Semi-Autonomous Governmental Agency (SAGAs) that contribute to national growth and development through their functions in research and development, regulatory and commercial.

3.3.3 The National Development Plan 2018-2022

The twelfth 'National Development Plan (NDP 2018-2022)' aims to stimulate sustainable economic growth and reduce poverty through the government four agenda, that's affordable housing, comprehensive health care, food security and manufacturing. These aim at effective management and implementation of prudent macro-economic policies as stipulated in Vision 2030. The plan clearly articulates issues in three sectors namely Agriculture, Industrialization and Human security; the enabler in these three sectors is the S&T. The Agriculture and Rural Development Sector, being the backbone for Kenya's socioeconomic development, recognizes among others modern means of livestock development, fishing, beekeeping, food security and arable land use policy as areas of focus, in alleviating poverty and therefore combating draught, desertification and other effects of Climate change.¹³⁰ The Industrial sector highlights on harnessing technology on manufacturing by value addition of the locally available materials and exporting them as finished products, that way they accrue better prices in the world market and are able to compete favorably. Human security covers various aspect of health security, environmental security, food security, personal security, political security, community security and economic security.

¹³⁰ Ibid, (2017).

Others S&T Guidelines

National Commission for Science, Technology and Innovation (NACOSTI); to oversight, regulate and assure quality in the science, technology, innovation and has the authority to oversee and license any research undertaken. It also advises the Government on issues related thereto. Kenya National Innovation Agency (KENIA); develops and manages the Kenya National Innovation System for the main purpose of coordinating linkages between universities, research and tertiary institutions, the private sector, the Government, and other interested actors. National Research Fund is supposed to hold a sum of money amounting to two percent (2%) of the country's total budget, provided by the Treasury every financial year. These monies are to facilitate research for the advancement of appropriate science, technology and innovation for country's use. NACOSTI also has the mandate to establish a Research Advisory Committees to evaluate, analyse and advise it on the programmes and projects essential to implement the scientific priorities arising from the national policy and the concomitant budget requirement

3.4 The Future trends of Science, Technology and Innovation in Security in Kenya

The United Nations, the 2030 Agenda for Sustainable Development sets ambitious global goals, demanding unparalleled actions and efforts by countries across multiple interconnected socio-political, economic and environmental issues. Science, technology and innovation (ST&I) shows a central role in the attainment and achievement of these goals.¹³¹ The process of creative transformation initiated by science and technological progress can help to alter economies and improve welfare and living standards of people, by cumulative productivity, reducing production costs and prices, and helping to raise real wages for the working population.

¹³¹US National Science Board. *Science and Engineering Indicators 2016*. Chapter 7. Arlington, Virginia: National Science Foundation, 2016.

Effective and applicable science communication is not modest.¹³² Africa has experienced its various shares of challenges in dealing with many controversial issues such as genetically modified foods and genetic pharmaceutical products and has learned a lot while engaging the general public with knowledge base science.¹³³ Science and technology are not a Constance; they continue to advance at a progressively rapid rate, and discussion of the issues that arise from these developments. To keep pace with this requires technical knowledge based education system.

This study illustrates that substances of science, technology, engineering, mathematics, innovation, research and development in the Kenya context, over the years have experienced rapid industrial growth especially in security, agriculture, natural resources, medicine and ICT sector. Most of scientific innovations are supported by funds and aids from abroad. Recently, innovations in utilization of computer software and hardware technology and embedded systems have gained universal dominance in the public domain due to availability, affordability and ease of access.

The role of national science technology and innovation systems in security and defense is highly topical and indeed noticeable, because of the complexity, encoding and confidentiality of the technology convoluted and the desire to get value back for money expended on research and development and venture. This is economical especially from end to end the commercialization of defense-funded technology that is not easily got. Analogue and labor-intensive technology transfer requires a strong commitment from both private and public sector.¹³⁴ The lack of Intellectual Property Rights (IPR) culture in industries technology makes it difficulty and failures in spin- off attempts in Africa.

¹³²McGann, J. G. "2016 Global Go to Think Tank Index Report". University of Pennsylvania, January 26, 2017.

¹³³Republic Of Kenya, Sector Plan For Science, Technology and Innovation 2013-2017.

¹³⁴Mwagiru, Makumi. *African Regional Security in the Age of Globalisation*, Nairobi, Heinrich Boll Foundation, (2004), p. 12-18.

The study reserves that some domestic social and economic benefits of military-inspired technical production are advanced. New materials developed, inventive consumer products made available. It is equally obvious that once such a discovery is set in motion halting the political economic influence from defense linked spending is impossible. In short, from it appears the country is on the access of a new transformation in knowledge acquisition and production concluded changes in funding, research and innovation.

In the Kenyan perspective, the rapid development and deployment of engineering capability to UN peacekeeping missions is a very urgent requirement and timely response when intervention is strongly required. The rapid deployment of equipment and troops, into well located, positioned and defended camps, can greatly improve preventive conditions on the ground, build confidence and restore hope in a fragile peace, provide stability and restore peace to tense areas and guarantee the UN supports and maintains the peace that so many wish for. To support the rapid deployment of troops, there have been various efforts made to speed the missions' start-up and react to changes in United Nation mandate.

The African Rapid Deployable Engineering Capability (ARDEC) notion is quick deployment of engineering competence to UN and AU peacekeeping missions, principally in Africa. This involves the providing of Military Electrical and Engineering Contingents (MECs) from Troop Contributing Countries (TCCs) in site vertical and horizontal construction/commissioning. The generous contribution and support from Japan allowed the United Nations Department of Fields Support (UNDFS) facilitates scheming a pilot trial scheme named Triangular Partnership Project incorporating, Japan, the United Nations and Kenya. This aimed at strengthening military engineering capability for UN peacekeeping at the Humanitarian Peace Support School (HPSS) in Embakasi garrison, Nairobi. The programme incorporates regional partakers from Uganda, Tanzania, Rwanda and Kenya. The rapid disposition enhances timely response to crisis management.

Among the engineering skills acquired by the trainees are road and accommodation construction and repair, airfield structure and rehabilitation, helipad and runway construction/rehabilitation, campsite and infrastructure preparation, transport and communication, recovery and maintenance of substantial manufacturing apparatus, military (pre-fabricated) bridging and drilling of boreholes.¹³⁵ It is significant to note that science and technology has its own exclusive encounters and constraints, social media has an undesirable effect in many family relationship units at variable intensity. Communication through gadgets has replaced personal communication while unsupervised and unsuitable content on social media tend to influence children and youth negatively.

Conventional military aggressive operations require combat and structural engineers to provide them with mobility and sailor ability by constructing bridges, tracks, helipads and airfields. Engineer capabilities also support offensive and defensive operations through construction of combat trenches, bunkers, storage areas, ammunition points, clearing hindrances, carrying out various demolitions, deceptions, bomb disposals, water source structure/drilling, review and map processing and production. The clearing, building and operation of electrical and mechanical connection storages including fuel based, construction of housing and sanitary service facilities, construction and reinforcement of field defences (fortifications and obstacles) and breaching and passage of obstacles and barriers among others.

Present peace operations in Africa have many personal and logistical challenges including financial limitation, supply, storage, transportation and engineer capitals. These confines reduce the effectiveness and efficiency of deployed forces in achieving their mission objective of renewal, care and provisions of peace and normality in their areas of operation. Local populations in the theatres of action presume to gain in various ways comprising the Quick

¹³⁵ Fulgence N (2015) War on Terrorism in Africa: A Challenge for Regional Intergration and Cooperation Organizations in Eastern and Western Afric.

Impact Projects and bequest of the facilities developed, created and later passed over to them by the deployed forces. One of the encounters experienced in AMISOM processes has been the resources to win the “hearts and minds” of the local populace. Effective engineer exertions will close this crack by bringing Quick Impact Projects to sustenance the populace over improved Civil Military Cooperation actions. This will be one of the aids from the Triangular Partnership Project contained by the UN Peace Operation reforms.

3.5 Conclusion

In conclusion, science and technology in itself is unbiased. It brings aids to sustenance the progression of human beings and support their livelihood. However, it also spawns threats or creates encounters and menaces such as climate change, communicable diseases, as well as dynamic annihilation and cyber-attacks. The benefits of S&T have been considered and deliberated in particulars in the following section. As science and technology produces threats or creates jeopardies and challenges, one should evaluate its part in security holistically. Moreover looking at science and technology from the predictable military and homeland security perspective, research needs to scrutinize it from human security: environmental, the economic, personal, diplomatic, moral, shared, and policy angles.

In the African perspective, science and technology accomplish the roles of affecting societies, possessions and amenities transversely and within borders. It is used in caring civil rights and homeland safety. Science and technology is used in distant sensing and uncovering, biometrics, information sharing and incorporation, modeling, imitation, risk scrutiny, cyber threats and in defying threats to precarious infrastructure, allow legal information to be conveyed to the suitable homeland defence authorities.

CHAPTER FOUR

HARNESSING SCIENCE TECHNOLOGY AND INNOVATION IN ADVANCING KENYA'S NATIONAL SECURITY

4.1 Introduction

This chapter presents the comprehensive outcome of the inquiry of the data unruffled on the role of science, technology and innovation in national security in Africa using Kenya. This study will mix both qualitative and quantitative research approaches relying on both primary and secondary data sources. This study acknowledges that primary data was captured through a structured questionnaire and secondary data was collected through books, journals, articles and periodicals. The collected data was sorted and analysed using document analysis and thematic analysis techniques. The results of the study were presented in form of pie charts, bar graphs, tables and narrative form.

This study aims to contribute to effective policy making informed by provision of deeper understanding on the role of science, technology and innovation in national security. In addition this study seeks to contribute to action oriented strategies by governments, security managers, concerned agencies, actors and stakeholders in Kenya and the rest of Africa as a whole. A total of 35 respondents successfully completed the questionnaire(s) out of the 50 originally administered for the study. This represented (70%) response rate which the study considered adequate for the analysis. The concepts considered in this study for the respondents to articulate included; science, technology, innovation, research and development changes in the global security environment impact on the management of security, new forms and sources of insecurity brought about by the changed international environment. The respondents who participated in this research included professionals in ICT technical roles, ICT security officers, financial institutions, academia, diplomats, legal institutions IT institutions and others. The following institutions were targeted: Ministry of Foreign Affairs Kenya, Communication

Authority of Kenya, Kenya Defence Forces, Kenya Police (NP) and National Intelligence Service (NIS) Head Office Nairobi, Central, Safaricom, University of Nairobi, and Technical University of Kenya.

4.1.1 Designation Distribution

This research shows that the results, 9 percent of the respondents were executives, 28 percent were senior managers, 23 percent were junior managers, 14 percent were supervisors, 17 percent were technicians and 9 percent were junior staff as shown in Table 4.11 This shows a fair representation across the management and supervisory levels of the institutions suggesting that link between science, technology, innovation, research and security.

Table 4.1: Designation Distribution

Designation (ICT)	Frequency	Percentage (%)
Executives	3	9
Senior managers	10	28
Junior managers	8	23
Supervisors	5	14
Technicians	6	17
Junior staff	5	14
Total	35	100

Source: Author (2018)

4.1.2 Age Distribution

The age distribution of the respondents was sampled in groups of nine years interval. The results were that 5 percent were below the age of 30 years, 42 percent were between the ages of

30-39 years, 32 percent were between the ages of 40-49 years and 21 percent were between the ages of 50-59 years as shown in Table 5.4. This shows that the ICT department is managed by fairly aged senior staff of between 30 to 50 years of age. This also shows the level of maturity and experience that helps to meaningfully contribute to the study.

Table 4.2: Age Distribution

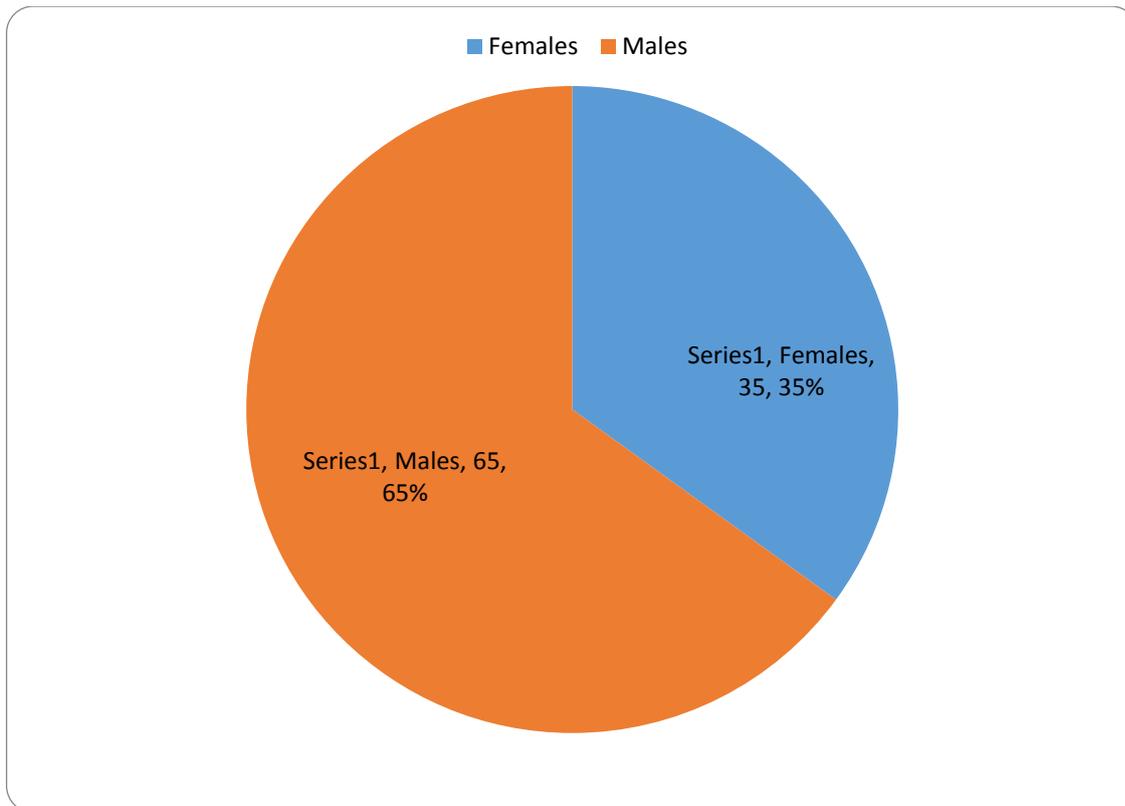
Age (years)	Frequency	Percentage (%)
Below 30	2	5
30 – 39	31	42
40 – 49	12	32
50 – 59	8	21
Total	35	100

Source: Field data (2018)

4.1.3 Gender Distribution

The gender distribution of the respondents was made and 65 percent were male while 35 percent female as shown in **Figure 4.1**. This shows that the science, technology and innovation sector is well represented with over 30 percent gender distribution as required in the Kenya Constitution, 2010. This shows a balanced representation which improves the reliability of findings.

Figure 4.1: Gender distribution

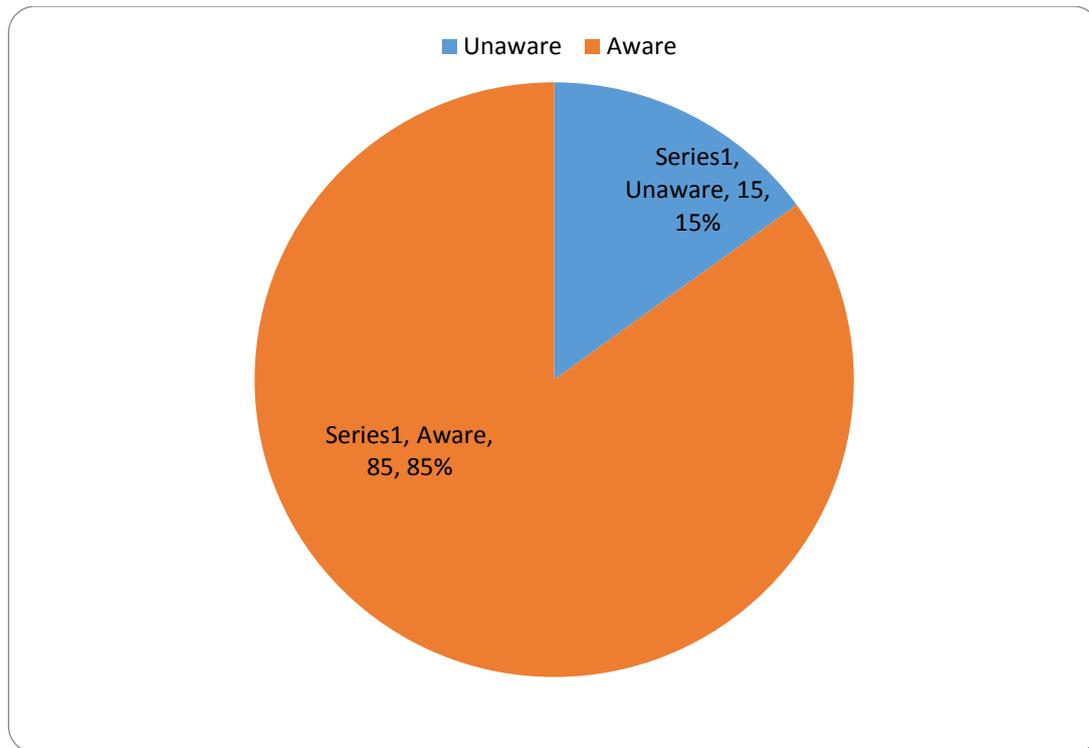


Source: Author (2018)

4.1.4 Knowledge on Science and Security

The study sought to determine the respondents' knowledge of the nexus between science and technology. From the findings 85 percent agreed that they understood cyber threats while 15 percent were unaware as shown in **Figure 4.2**. These results suggest that majority of the respondents were aware of the threat and therefore can successfully respond to any attack. The few who were unaware may likely be the apprentice junior staff on training and therefore improves the validity of this study.

Figure 4.2: Knowledge on the nexus between science and technology



Source: Field data (2018)

4.1.5 Science, Technology, Innovation and National Security

This research sought to determine if science and technology has a direct influence on a national security. The outcome showed that 55% strongly agreed, 20% Agreed, 15% were undecided and 10% disagreed as shown in **Figure 4.3**. From field study, the respondents from the security sector such as Kenya Defence Forces, National Police Service, National Intelligence Service and the Banks positively related the threats to national security. The respondents who agreed could not elaborate how it was precisely linked to security of the nation.

4.2 The Latest Emerging Security Threats in Africa

This study found that majority of the respondents (85%) indicated that the traditional concept and perception of security is generally mandate and lies at the state policies, therefore the defense and preservation of its sovereignty and territorial integrity. In support of this,

Christopher Clapham opines the following, that “threats to the security of the state are therefore seen as essentially emanating from a hostile external environment, defined in terms of other states which recognize no other authority beyond theirs. In this anarchic situation, containing such threats relied mainly on self-help and armed military might. Global security in the new world order compels each state to conceive its security and stability as being closely linked with those of its neighbours. This is particularly so in Africa which still confronts the unresolved problem of state formation and its conflict generating propensity. The post-Cold War era of Afro-fatigue has thrust upon the continent the onus of resolving its own conflicts, sometimes with, and often with no timely interest shown by the wider world.”¹³⁶

It is important to appreciate right from the onset that the twenty-first Century marked the closure and the beginning of many things around the globe, and while it brought an end to the dual super-power engagement in international politics, it also paved the way for the need to redefine some core issues in international relations, especially those concerning security. Security is a core value of human life. Sheehan states that the meaning of security is often treated as a common sense term that can be quickly understood by unacknowledged consensus.¹³⁷ According to Mwangi, the end of the Cold War had remarkable changes in the political, economic, social and cultural structure of the international system.¹³⁸ The changes were marked by decline in ideological and super power conflicts, democratization process, technological changes and globalization.

From a human security perspective it is possible for inhabitants of a secure State to suffer insecurity. This comes about in that individuals or communities could be affected by a number

¹³⁶Christopher Clapham, (2010) “Sovereignty and the Third World State”, in Jackson, ed., *Sovereignty at the Millennium*, p. 101.

¹³⁷Sheehan, Michael. *International Security: and Analytical Survey*, London, Lynne Rienner Publisher, (2005), pp. 89-92.

¹³⁸Mwangi, Makumi. *African Regional Security in the Age of Globalisation*, Heinrich Boll Foundation, (2004), p. 31.

of non-military atrocities that threaten their wellbeing just as an invasion from a foreign army would. These factors include famine, ethnic strife, and discrimination in state resource allocation, diseases, religious and cultural persecution among others.¹³⁹ This would often happen in a State that is not facing the threat of aggression from external sources and therefore could mistakenly be perceived to be secure.

Cawthra argues that “if existing security resources and opportunities when well harnessed and exploited, African countries could advance its own national development aspirations and hence national security is a cornerstone of development and progress in a free society and thus a basic and widespread understanding of the importance of national security as a guarantee of citizens’ well-being and the stability of the State itself is therefore essential.”¹⁴⁰

Globalization brought a phenomenon where borders are increasingly diminishing thus allowing for more interactions.¹⁴¹ This has enabled the thriving of such illegal trade as drugs, arms and human trafficking, money laundering, cybercrimes, poaching and terrorism among others. In the light of this, the definition of national security must acquire a new meaning that will take into account threats from external non-state actors. According to Adedeji, “Nigeria has witnessed an unprecedented level of insecurity and this has made national security threat to be a major issue for the government and has prompted review of the challenges to national security implementation process.”¹⁴²

It may appear that issues of security are local oriented, the domestic scene cannot be seen in isolation from regional and international dynamics. In this regard, changes brought about by radically changed political, economic and social conditions in Southern have had an

¹³⁹ Ibid, (2004), pp. 12-13.

¹⁴⁰ Cawthra, Gavin. *Political and Security Negotiations and Security Sector Transformation in South Africa*, in Dudouet, V., Giessmann, J. and Planta, K. *Post-War Security Transitions: Participatory Peacebuilding After Asymmetric Conflicts*. Abingdon: Routledge, (2012), p. 42.

¹⁴¹ O’Heffernan, Patrick. *Mass Media and American Foreign Policy*. New Jersey, Ablex, (2011). p. 64.

¹⁴² Adedeji, Eziyi. *Urban Environmental Problems in Nigeria: Implications for Sustainable Development*, *Journal of Sustainable Development in Africa*, Volume 12, No.1, (2010), pp. 124-145.

effect on the implementation of national security in the region. For example these changes heralded the following into the South Africa scene; democratisation and political pluralism, rapid technological changes and liberalisation of the economy.

Kenya faces the challenge of threats to national security that is emerging from the widespread use of cyber technology. For example, cyber technology has been used to break into government networks, financial institutions and security offices to gain access to information. Kenya, in view of the foregoing has put in place intervention measures, the problem still persists with dire consequences. The intervention measures appear to be ineffective to stop emerging security threats. If the problem is not adequately addressed, its management will be complex to handle in future.

4.3 Science, Technology and Innovation in Kenya's National Security

The continent of African is considered to be a rapid growing continent in the use of Information Communication Technology (ICT) both in public and private sector. This has been made possible by the freedom and independence in the sector where both corporate and individuals competes freely in the market. According to Internet World Stats (2017), Africa has 388million internet users translating to about 10 percent of world users.¹⁴³ This number has attracted international investors into the continent wishing to cash in the market opportunities presented. Equally, ICT Africa believes that the continent is growing to be a leading technology hub in the world which is likely to see Africa grow vastly.¹⁴⁴ MacAfee argues that innovation increases availability, use and application of internet drastically.¹⁴⁵

Despite the consensus on the foundations of security concept, a universal definition of national security does not currently exist; therefore making it difficult implementing national

¹⁴³ Internet World Stat, 2017

¹⁴⁴ Moeng, B. 2011. 9 Reasons to invest in Africa ICT. IT News Africa 14 September. Internet: <http://www.itnewsafrika.com/2011/08/9-tech-investment-opportunities-in-Africa>. Accessed 05 November 2017.

¹⁴⁵ MacAfee 2014, MacAfee Labs Threats Reports. Internet <http://www.macfee.com/hk/resources/reports/rp-quarterly-threats-q1-2015.pdf>

security strategy entails all the facets of security. Hence to effectively deal with threats to national security, an analytical approach to country specific, regional and global threats is now required and this will be is only possible if both scholars and practitioners are knowledgeable of the existence of the threats. For instance Kenyan Governments have had to deal with various kinds of threats to national security that span the entire period from independence to date. The extent to which successive Kenyan Governments have responded to the threats in the past and an assessment as to how well prepare the current Government is to deal with present and future threats will be delved into.

Tom Jackson, agree with this position and notes that owing to the continent's weak economic base, the development of information communication technology (ICT) industry has lagged behind as compared to the rest of the world.¹⁴⁶ However, only recently fibre optic cable linking Kenya to other continents and regions was laid thereby increasing the broadband network coverage significantly. Consequently, it has likewise increased the number of Internet users immensely. While the continent is ranked amongst the fastest growing in the world, the ratio of Internet users to the local population or Internet penetration rate remains at 30.5%, which is considered to be quite low in compared to global standards.¹⁴⁷ Similarly, despite of this low turnover, the overall rate of Internet development amongst the states in the continent is high.

The relationship between cyber technology and in-security is a complex phenomenon but equally important. The development in the cyber space technology and the rising cybercrime present a relationship that is of concern to national security. The existing literature shows that

¹⁴⁶ Tom Jackson, "Can Africa Fight Cybercrime and Preserve Human Rights?", April 10, 2015, <http://cybersecuritycaucus.com/can-africa-fight-cybercrime-and-preserve-human-rights>, 2015-06-02.

¹⁴⁷ Council of Europe 2004. Organised crime situation report 2004: focus on the threat of cybercrime. [Organised_crime/Documents/Organised%20Crime%20Situation%20Report%202004.pdf](http://www.coe.int/t/e/treaties/organised_crime/Documents/Organised%20Crime%20Situation%20Report%202004.pdf)

as technology advance, so is does the threat landscape. Due to this development, the criminals equally use the same to scale their operations an exploitation of the expanding network.

Kenya has made great strides to embrace technology in automating its business processes. The country has been recognized internationally for innovating M-pesa mobile money service platform however, this growth seems to be challenged by the evolving threat of cybercrime. Considering the fact that with the existing measures and strategies to safeguard the ICT sector, cyber security is fundamentally an asymmetric problem. This withstanding, there is indication that there is likelihood of existing gaps in the security laws, poor information security policies or lack of awareness of information security issues, this thesis seeks to investigate.

4.4 Harnessing Science Technology and Innovation for Kenya’s National Security

This study found that science, technology and innovation have changed the business landscape in Africa. According to Kenya cyber security report 2016, “Africa has witnessed an increased usage of internet penetration in the last decade. However, as the continent digitalize its business processes, the potential attack by cybercriminals become more complex”.¹⁴⁸ The attack target weaknesses in the technology infrastructure and processes leading to huge loss of finances and valuable information.¹⁴⁹

The continent is characterized by fast development in the use and application of Information Communication Technology (ICT) both in public and private sector. This has been enabled by the independence in the sector where both corporate and individuals compete freely in the market. According to Internet World Stats (2017), Africa has 388million internet users showing about 10 percent penetration.¹⁵⁰ This has attracted a huge number of international investors into

¹⁴⁸ KENYA CYBER SECURITY REPORT 2016

¹⁴⁹ Evans, D. (2011) ‘The Internet of Things How the Next Evolution of the Internet Is Changing Everything’. Cisco white paper Cisco Internet Business Solutions Group (IBSG)

¹⁵⁰ Internet World Stat, 2017

the continent with a view to exploit the opportunities presented by the market. Similarly, ICT Africa believes that the continent is growing to be an important technology hub in the world which is likely to fast track its growth.¹⁵¹ Since Africa has majority youthful population of between 25 – 35 years who often use internet, the continent ICT penetration greatly grown compared to rest of the world.¹⁵² Kenya's ST&I system is based on foundations over 100 years old. The first research institutes were set up by the colonial government including the Scott Agricultural Laboratories in 1903, the Coffee Research Services in 1908, the Veterinary Research Laboratories in 1910 and the Medical Research Laboratory in 1958 (Adhoc committee on ST&I and KNAS). Following independence the country saw its first Science and Technology Act come into force in 1977. This established the National Council for Science and Technology (NCST) to coordinate science and technology policy development and implementation. NCST also had a role in funding research in Kenya although this role was less clearly articulated.¹⁵³

This study found that according to Kenya Vision 2030, ICT forms a major priority driver for the government to achieve the national development goals. Since then, Kenya has witnessed increased use of internet which stands at 40 million and 90 percent penetration as at 2016.¹⁵⁴ The country is connected to the world through four fiber optics undersea cables which offers an improved speed of six terabytes per second. This speed has enabled large capacity of data to be processed faster hence making it a cheaper connectivity. Through M-Pesa which is an internet banking technology service provider in the country has recorded over 30 million

¹⁵¹ Moeng, B. 2011. 9 Reasons to invest in Africa ICT. IT News Africa 14 September. Internet: <http://www.itnewsafrika.com/2011/08/9-tech-investment-opportunities-in-Africa>. Accessed 05 November 2017.

¹⁵² eMarketer, "eMarketer in review – key 2013 trends, coverage areas and platform growth", Newsroom, 4 September 2013. Available from www.emarketer.com/newsroom/index.php/emarketer-review-key-2013-trends-coverage-areas-platform-growth/#UG1Ch9mS5hMlp1JX.99

¹⁵³ Moeng, B. 2011. 9 Reasons to invest in Africa ICT. IT News Africa 14 September. Internet: <http://www.itnewsafrika.com/2011/08/9-tech-investment-opportunities-in-Africa>. Accessed 05 November 2017.

¹⁵⁴ Communication Authority of Kenya, 2016

mobile money subscribers with about 25 million internet users (CAK, 2016).¹⁵⁵ The fast growth of ICT in innovative technologies shows how Kenya has become independent to the sector. The government has largely utilized ICT platform to provide services such as job advertisements, Huduma center services, i-tax, e-payments, e-farming, business transactions and others. This exposed the country to cyber security threats.

In 2014, Kenya experienced increased cyber-attacks targeting both private and public sectors. Consequently, due to the increased dependence on ICT has meant that Kenya faces an emerging threat to national security. In response to the rising vulnerabilities, Kenya has established a national cyber strategy that is aimed at protecting the nation.¹⁵⁶ Despite these measures, the number of cyber-attacks continues to increase. As noted by CAK, the existing cyber security measures are generally passive in nature and thus fail to transversely cover the full span of operations. However, despite the multifaceted approach put in place in combating the threat in Africa, little information is available on Kenya's preparedness to face the nascent nemesis. This reality still remains constant today and it is for these reasons that the study aims to analyze how cyber technology affect security in Africa, using a case study of Kenya.

This study found that the reason for liberalization can be attributed to the factors such as increasing political stability, higher commodity prices and reforms in most areas of the economy. As for case of Kenya mobile banking, the use of mobile phones is widely utilized in Mobile Money Transfer Services which is referred to as M-Pesa. In addition, the decision by Kenya to adopt e-government and e-commerce has opened window for transparency and a means to fight corruption through the e-data enterprise

This study found that ICT has been applied to enhance food security which is a critical commodity for the survival of the population and ultimately the nations. However, the

¹⁵⁵ Communication Authority of Kenya, 2016

¹⁵⁶ Hold Security, 2014. *You Have Been Hacked!* Internet//<http://www.holdsecurity.com/news/cyberwor-breach>.

agriculture sector in Africa has performed dismally in the last 40 years due to lack of embracing ICT. African agriculture is basically regarded as traditional as it relies on low-yielding production mainly rain-fed and lacks access to market information and financial support services which is provided by the technology. The role that ICT has played in addressing these challenges has been enhanced by the use of mobile phones.

The growth in ICT, presents exclusive opportunities for monetary service sector expansion in Kenya.¹⁵⁷ These advances cover all sides of the financial service sector ecosystem, from data storage and sharing, security, and analytical processing. All these are critical enablers for a booming financial service sector in the continent. For example, despite the political and ethnic conflicts experienced in Kenya, the country has utilized ICT in the economy especially in information and marketing as compared to her East African Community (EAC) states and the wider Africa region.¹⁵⁸ Kenya serves as a communications center for the region, with most of its businesses gradually aiming to establish a regional footprint in ICT development.

The Central bank of Kenya (CBK) the banking sector has recognized the use of M-Pesa services as a facility which provides financial transactions services to lower-income consumers.¹⁵⁹“There is both competition and co-operation between mobile money and the banking industry, but banks have recognized that it is useful for clients to connect their mobile money account to their bank account, and the likelihood to increase their revenues has helped to reduce their opposition to mobile money as an immediate competitor, while increasing the offerings available to consumers”.¹⁶⁰ In order to step up science and technology formal education must keep pace. The quality of Kenya’s higher education system has been routinely

¹⁵⁷ Mutua, W. (2011). The Significance of Mobile Web in Africa and in Future. [Http://www.wfs.org.significance.mobbile.web](http://www.wfs.org.significance.mobbile.web). Accessed 10 December, 2017.

¹⁵⁸ Kigen, P. M., Muchai, C., Kimani, K., Mwangi, M., Shiyayo, B., Ndegwa, D., & Shitanda, S. (2015). *Kenya Cyber Security Report 2015*. Serianu Limited.

¹⁵⁹ African News. (2010b). Kenya: Banks Fight to Secure Customers Deposits from Cyber Criminals. *Business Daily (Nairobi)*

¹⁶⁰ Balancingact-africa.com, (2010). Impact of Cyber Fraud on Kenyan Banking Sector, Devastating

criticized for not producing the type of graduates the country needs. In 2017 / 2018 / 2019 the government audited the country's universities (public and private) and found many wanting. On release of the report, the government immediately withdraw a number of types of university courses (school based teaching programmes and Executive Master of Business Administration), and gave all universities a month to correct irregularities with regards to enrolment procedures.

4.5 Conclusion

The vulnerabilities of Africa's cyber space to attacks is due to the growing digitalization without a corresponding defence capabilities. The degree of cyber risks is directly linked to the degree of growth in global digitalization. As observed, the institutions dealing with cyber security are not keeping in pace with the rate in which digital technologies are developing. Hence a lack of legal framework, infrastructure for enforcement mechanism, monitoring and coordination has not contributed to creating a secure cyberspace.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter summarises the whole study. The objectives of the study are again stated as well as the methodology used. The data presented, interpreted and analysed guides the researcher to make value judgement on the role of science, technology and innovation in national security in Africa using a case study of Kenya. The summary makes key conclusions and important recommendations on the way forward.

5.2 Summary of the Study

In order to enhance understanding of the problems under study, literature was reviewed eagerly following the research objectives that the study sought to achieve. The literature identified gaps existing in the ICT sector. The main objective of the study is to establish the role of science, technology and innovation in national security in Africa using a case study of Kenya. The specific objectives of the study included; To examine the latest emerging security threats in Africa, to determine role of science, technology and innovation in national security in Kenya, and to assess options of harnessing science technology and innovation in national security in Kenya.

It is acknowledged that ST&I activities do not just occur in a vacuum but, especially in the era of globalization, are influenced by external actors and events. In order to obtain answers to the objectives of the study, the researcher used both qualitative and quantitative methodologies. The study considered the efforts made by Kenya to address security threats. The study targeted respondents who included STI professional from various government ministries, security sector, diplomatic officials, academia, ST&I institutions and other sectors. The data was collected through the internet, libraries and the interviews which targeted ST&I professionals.

This study found that in order to establish the role of science, technology and innovation in national security in Africa using a case study of Kenya, it would entail strengthening technical capabilities through advanced training of personnel, improved infrastructure, equipment and strengthening linkages with actors in the production sector.

The literature presented in Chapter 3 and 4 indicate that Africa and Kenya has embraced e-economy as a national development priority and has further created security policies and legal framework to address the challenges facing the business infrastructure now and in future. However, the research notes that while Kenya has developed cyber security measures and strategies that include legal framework, they have not been able to address cyber security threats appropriately.

This study found that participants felt that coordinating national efforts, mobilizing resources and people, and providing overall direction should be the responsibility of government.

This study also found that a common issue for many countries in the region is limited access to funds for information, technology and infrastructure (such as for transport, ICT and research). In Kenya participants believe there is a failure to make effective use of research facilities, which may be linked to poor training and restricted accessed, and there are poor links between R&D and both the public and private sectors.

5.4 Conclusions

Basing on the objectives of the study and in view of the above findings, the following conclusions are drawn; ST&I also a native shield of protection due to its worldwide geographical area, where at a distance of a mouse click we could order actions from one corner to any other corner of the world and thus there is a relationship between cyber technology and in-security. Thus this study concluded that these were a strong relationship of correlation between the growth in technology and in-security. The increased advancement in technology

has led to increased cybercrime. The research found out that there was gross lack of cyber threat awareness amongst many internet users. This level of ignorance allows the criminals to continuously attack without any form of alertness to facilitate mitigation.

This study concludes that Kenya has strong linkages between knowledge based institutions (universities and research institutes) and government agencies but few other linkages and none of any note between the medium and high technology industry and knowledge based institutions.

5.5 Recommendations

This study thus recommends the following:

Technical Education

Education is a must for technical staff of organizations and companies as well as for cyberspace user. There is a growing use of cyberspace on financial and e-government activities, relaying on cyberspace important issues of private and social modern societies, demands a fast and organized education about the risks of cyberspace, thus there is need for cyber situation awareness to sensitize general Internet and ICT users on the risks they are exposed. There is need to involve academia in research and development (R&D) including innovation to develop appropriate computer protection that is easy to use and less costly.

5.5.4 Security and Risk

It is important to note that like two sides of the same coin, S&T could generate risks and protect security, and both risks and security are intertwined. Risks must be managed properly to protect security. For example, guns could be used to defend ourselves in the wild, but they could also be used to kill ourselves. Kenya is still far from reaping the full benefits of ST&I revolution of the 21st century. The country still grapples with a myriad of challenges ranging from slow

economic growth, food insecurity, and poor environmental management to low industrial base. In addition, it is also important to realize that Science and Technology, has some setback. The negative effects of S&T on society, some of which include unemployment; most skilled people are the ones whose abilities are better amenable to technology. To this extend, technology is a driver of inequality of income among workers of varied skills. Use of robotics in production processes invariably has led to reduction of labour force.

In today's interconnected world, the security issues in one country can potentially affect not only its neighbors but the wider region. No single country or agency alone is able to tackle the full range of maritime safety and security issues.

The mandate of EASF, being one of the African Standby Forces, is to enhance peace and security in the region. This mandate covers the entire spectrum of operations which includes air, land, maritime and space. The Maritime Domain therefore is a very vital area as its situation directly affects every facet of development in all states, coastal and landlocked. It is for this reason that EASF 2012-2020 Strategic Plan features a specific objective on Maritime Safety and Security Mechanisms. Establishment of the MCC within the Maritime cell will therefore be a key milestone towards safe and secure maritime domain.

5.6 Suggested Areas of Further Studies

Science diplomacy think tanks should advise and assist the government to build strong and effective international relationships.

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APPENDICES

Appendix 1: Study Map of Map I

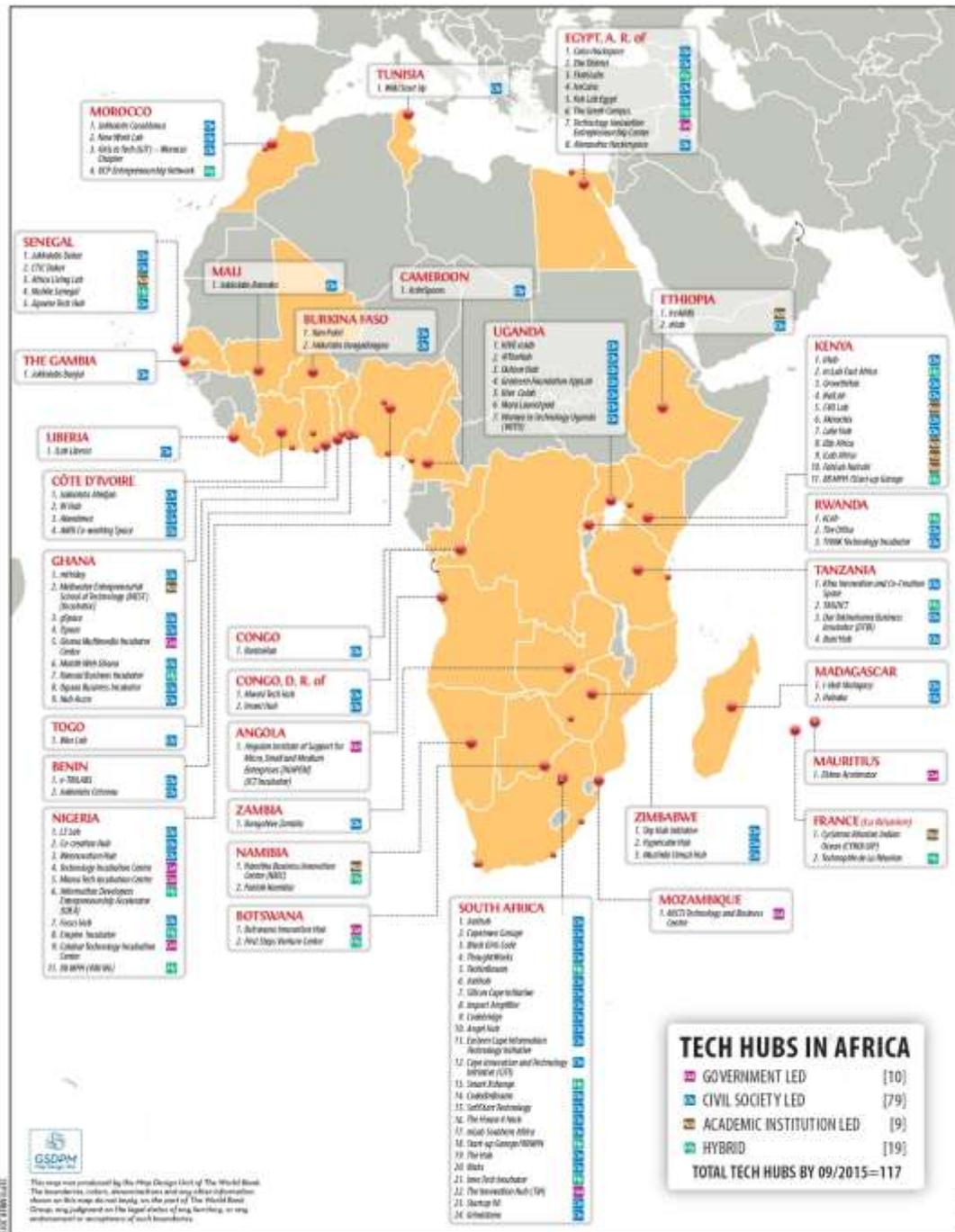
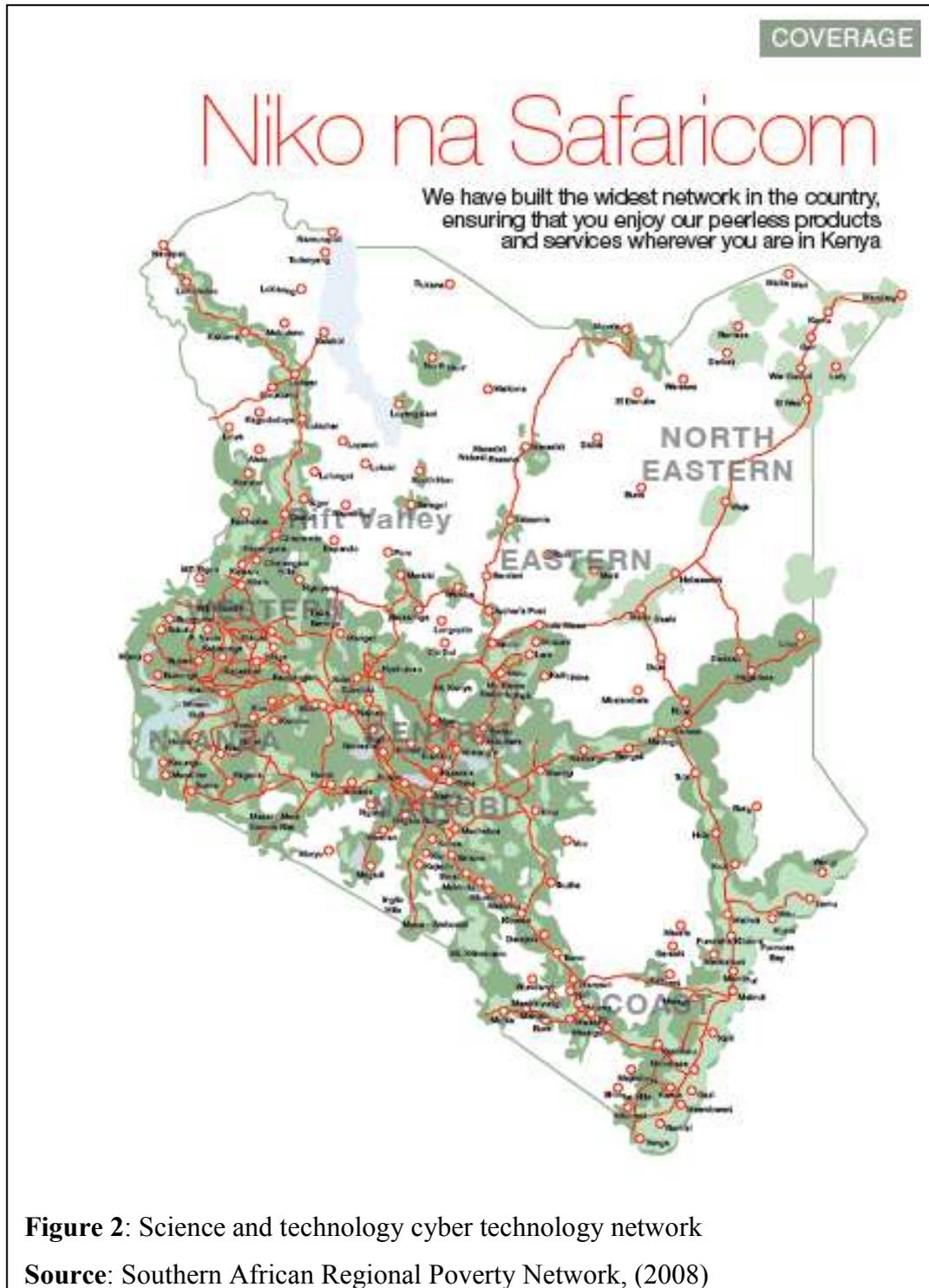


Figure 1: Technology hubs in Africa

Source: Google (2018)

Appendix 2: Study Area Map 2



Appendix 5: Research Questionnaire

The study aims to establish the role of science, technology and innovation in national security in Africa using a case study of Kenya. It is required that you give a verbal consent to be a participant in this research study - for academic purposes only. Kindly do fill-in the questionnaire appropriately based on the instructions provided.

Part A: Participants Information

Your age range?

.....

Your job description?

.....

Your organization of work?

.....

Designation?

.....

Your duration in office?

.....

In brief, how would you define science?

.....

In brief, how would you define technology?

.....

In brief, how would you define innovation?

.....

Part B: Science, technology and innovation in national security

Please rate the following statements on foreign policy diplomatic engagement.

Where 1 = Very much; 2 = Moderate; 3 = A little; 4 = Not at all.

Can it be said that there are many emerging security threats in Africa today?

Rate.....

Reasons.....
.....
.....
.....

Would you say that science, technology and innovation plays a role in security?

Rate.....

Reasons.....
.....
.....
.....
.....

There is a connection between science, technology and innovation and national security?

Rate.....

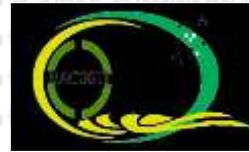
Reasons.....
.....
.....
.....
.....

That their various national approaches to utilizing science and technology for national security in Kenya?

Rate.....

Reasons.....
.....
.....
.....

Thank you.



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