INNOVATION SYSTEMS FOR NATIONAL ECONOMIC COMPETITIVENESS: A COMPARATIVE ANALYSIS OF BOTSWANA AND NAMIBIA

A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF BUSINESS ADMINISTRATION

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ABSTRACT

There is also a growing interest from African policy makers-practitioners on how best to configure their national systems of innovation in their respective countries. Many countries including Botswana and Namibia, have embraced the concept of national systems of innovation into their national policies for science, technology and innovation. The study did literature review on theories, models and characteristics of National Systems of Innovation, including science, technology and Innovation (STI) policies from both countries and how these STI policies drive wealth creation as well as outlining challenges faced in implementing the STI polices, aspects of university industry linkages and role of government in creating an enabling environment. The methodology adopted by the study was Mixed Method research design which was a pragmatic philosophical worldview of explanatory sequential mixed methods that compared Botswana's and Namibia's National Systems of Innovation for economic competitiveness. This study presented findings of a comparative analysis of innovation systems for national economic competitiveness for Botswana and Namibia by concluding that, lack of evidence-based STI policies developed with clear implementation plans, weak linkages between industry and higher education institution, including research institutes fragmented systems or nodes of innovation, hampers economic growth and development. Finally, the study recommended for policy cohesiveness that encourages consistency in governance and coordination of science and technology portfolios to promote social innovations, strengthening linkages between governments, higher education institution & industry, support physical infrastructure for research & development, through committing funds for the procurement of equipment needed by scientists and technicians in both countries. The study has both practical and academic importance. Firstly, it provides solutions to questions constantly asked by academic practitioners and policy makers on how to customize the concept of a National System of Innovation, which is modelled on knowledge-based economies to an African situation and how it helps nations gain national economic competitiveness. Secondly, the study contributes to the body of knowledge by generating literature and closing the knowledge gap on the application of the innovation system concept to resource-based economies like Botswana and Namibia.

List of Acronyms

AGIBUSDEV	Agricultural Business Development Agency
ARIPO	African Regional Intellectual Property Organisation
AMCOST	African Ministers Conference on Science and Technology
AMP	Advanced Manufacturing Programme
AMTA	Agro-Marketing Trading Agency
AOSTI	African Observatory on Science, Technology and Innovation
ASTII	African Science Technology and Innovation Indicator Initiative
AU	African Union
BBS	Botswana bureau of Standards
BDC	Botswana Development Corporation
BHC	Botswana Housing Corporation
BIH	Botswana Innovation Hub
BIPA	Business Industrial Property Authority
BITRI	Botswana Institute for Technology Research and Innovation
BIUST	Botswana International University of Science and Technology
BNRDICC	Botswana National Research & Development Innovation Coordinating Committee
BOU	Botswana Open University
BRICS	Brazil, Russia, India, China & South Africa
BUANR	Botswana University of Agriculture and Natural Resources
BWP	Botswana Pula
CAADP	Comprehensive African Agricultural Development Programme
CED	Center for Entrepreneurship and Development
CEN-SAD	Community of Sahel-Saharan States

COMESA	Common Market for Eastern and Southern Africa
COSDEC	Community Skills Development Centre
CPA	Consolidated Plan of Action
COSDEC	Community Skills Development Center
CCF	Cheetah Conservation Fund
CEO	Chief Executive Officer
CEDA	Center of Entrepreneurial Development Agency
COP	Conference of Parties
CSIR	Council for Scientific and Industrial Research
CSO	Central Statistics Office
CVL	Central Veterinary Laboratory
DRFN	Desert Research Foundation of Namibia
DRST	Directorate of Research, Science and Technology
DUI	Doing-Using-Interacting mode of Innovation
ECCAS	Economic Community for Central African States
ECOWAS	Economic Community for West African States
EU	European Union
FNB	First National Bank
GERD	Gross Expenditure on Research and Development
GII	Global Innovation Index
GO-SPIN	Global Observatory of Science, Technology and Innovation Policy Instruments
GRN	Government of the Republic of Namibia
FDI	Foreign Direct Investment
FTE	Full Time Equivalent
HC	Head Count
HPP	Harambee Prosperity Plan

HRST	Human Resource, Science and Technology
ICT	Information Communication Technology
IGAD	Intergovernmental Authority for Development
IK	Indigenous Knowledge
IKS	Indigenous Knowledge Systems
IUM	International University of Management
IS	Innovation system
IT	Information Technology
Ltd	Limited
MADFS	Ministry of Agricultural Development and Food Security
MAWF	Ministry of Agriculture Water and Forestry
MMR	Mixed Methods Research
MICT	Ministry of Information, Communication and Technology
MOD	Ministry of Defence
MOE	Ministry of Education
MEAC	Ministry of Education Arts and Culture
MET	Ministry of Environment and Tourism
MELPSD	Ministry of Employment, Labour Productivity and Skills Development
MENRCT	Ministry of Environment, Natural Resources Conservation and Tourism
MFDP	Ministry of Finance and Development Planning
MFMR	Ministry of Fisheries and Marine Resources
MHETI	Ministry of Higher Education, Training and Innovation
MHEVTST	Ministry of Higher Education Vocational Training, Science and Technology
MMRGTES	Ministry of Mineral Resources, Green Technology and Energy Security

MRC	Multidisciplinary Research Centre
MITI	Ministry of Investments, Trade and Industry
MITSMED	Ministry of Industrialisation Trade Small Medium Enterprise Development
MTERST	Ministry of Tertiary Education Research Science and Technology
MWT	Ministry of Works and Transport
NAU	Namibia Agricultural Union
NACI	National Advisory Council on Innovation
NAMCOL	Namibia College of Open Learning
NAMFI	Namibia Marine Fisheries Institute
NBII	Namibia Business Innovation Institute
NCA	Northern Communal Area
NCCI	Namibia Chamber of Commerce and Industry
NCHE	National Council on Higher Education
NCRST	National Commission on Research Science and Technology
NDB	National Development Bank
NDP	National Development Plans
NDP3	Namibia Third National Development Plan
NDP4	Namibia Fourth National Development Plan
NDP5	Namibia Fifth National Development Plan
NEC	National Economic Competitiveness
NEI	Namibia Energy Institute
NGO	Non-Governmental Organisation
NIMT	Namibia Institute of Mining Technology
NNF	Namibia Nature Foundation
NEPAD	New Partnership for African Development
NNFU	Northern Namibia Farmers Union

NQA	Namibia Qualification Authority
NQF	Namibia Qualification Framework
RTD	Research, Technology Development
NRSTP	National Research Science and Technology Policy
NPRSTI	National Programme for Research, Science, Technology and Innovation
NRF	National Research Foundation
NSA	Namibia Statistics Agency
NSI	National System of Innovation
NTA	Namibia Training Authority
NTB	Namibia Tourism Board
NUST	Namibia University of Science and Technology
OAU	Organisation of African Unity
PCAST	Presidential Council of Advisors on Science and Technology
PM	Prime Minister
R&D	Research and Development
RISDP	Regional Indicative Strategic Development Plan
OECD	Organisation of Economic Countries for Development
TVET	Technical Vocational Education and Training
SACU	Southern Africa Customs Union
SADC	Southern Africa Development Community
SAIS	Southern Africa Innovation Support Programme
SME	Small and Medium Enterprise
SANUMARC	Sam Nujoma Marine Resource Coastal and Research Centre
SPSS	Software Package for Social Sciences
SOE	State Owned Enterprise
STEM	Science Technology Engineering and Mathematics

STI	Science, Technology and Innovation
STISA	Science Technology Innovation Strategy for Africa
SWAPO	South West Africa People’s Organisation
TIKA	Turkey International Cooperation Agency
TWAS	Third World Academy of Sciences
UIL	University Industry Linkages
UB	University of Botswana
UK	United Kingdom
UNAM	University of Namibia
UNCTAD	United Nations Conference on Trade and Development
UNESCO	United Nations Educational Scientific and Cultural Organisation
UNICEF	United Nations International Children’s Emergency Fund
UNIDO	United Nations Industrial Development Organisation
UMA	Union du Maghreb Arab
UNDP	United Nations Development Programme
USA	United States of America
USSR	Union of Socialist Soviet Republic
VTC	Vocational Training Centre
WIPO	World Intellectual Property Organisation
WSSD	World Summit for Sustainable Development
WTO	World Trade Organisation

Declaration of own Work

I, John Mukelabai Sifani hereby declare that this study is a true reflection of my own research, and that this work, or part thereof has not been submitted for a degree in any other institution of higher education.

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Sifani .... 25/02/2019..

John Mukelabai Sifani   Date

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Dedication

This work is dedicated to my parents, the late Mr. Philip Sifani Kwetu and Mrs. Mwale Veronica Kachele.

CHAPTER ONE: INTRODUCTION

1.1 Orientation of the study

Botswana and Namibia are developing countries that face socio-economic challenges such high levels of poverty, unequal distribution of wealth, income disparities and unemployment which warrant for the development of evidence-based innovation policies for national economic competitiveness. Therefore, the proposed study presents a heavy scholarship on national innovation systems and innovation policies explaining their relationship to national economic development and competitiveness of Namibia and Botswana. The effectiveness and efficiency of National Systems of Innovation (NSI) and National Economic Competitiveness (NEC) are regarded as crucial areas of research to government, policy makers, research and innovation agencies, administrators, industries, academic researchers, and innovators as well as local communities. This is because it helps in the maintenance and development of a nation's competitive advantage (Bartels, Ritin, & Andriano, 2016). Scholars like Porter (1990) looked at the effective and efficiency of NSI from a linearity complexity of a knowledge-based economy based only on the factors of production whilst Bartela *et al.,* (2016) dwelled on the non-linear complexity which encompasses ICT as a key enabler for knowledge creation. Furthermore, Mugabe (2009) urges that realising the sustainability of innovation policies is dependent on how innovative organisations within an NSI are in achieving environmental sustainability.

To understand the above phenomena, it is required for nations to use technological and social innovations for institutional change as well as the capability to detect market failures that might hinder change in technology and innovation processes. Therefore, governments need to put in place mechanisms that support and promote innovation policy regimes to create a culture of innovation and innovativeness among its citizens by focusing on the governance rather than on implementation of these policies (Mugabe, 2009).

Science, Technology, and Innovation (STI) are critical in economic change, human development, and national competitiveness (Balzat, 2006). They play major roles in enhancing the productivity and competitiveness of countries and enterprises, eradicating poverty, and disease, protecting the natural environment, and building inclusive societies. However, STI alone do not have inherent or intrinsic powers to positively change economies and drive sustainable development as this requires the involvement of government, industry, and academia (Etzkowitz, 2008).

On the other hand, development and use of STI can be attributed to cause some of the major global and local sustainable development challenges, including climate change, loss of biological diversity and social exclusion e.g. the use of a motor vehicle as a means of transport contributes to carbon emissions, plastics to environmental pollution, and aerosols to the depletion of the ozone layer. Therefore, for the countries to maximise the social and economic as well as environmental sustainability of the benefits of STI in mitigating these challenges, Namibia and Botswana have signed the Paris Agreement on the reduction of Carbon emissions issue of public concern (United Unions, 2016).

Designing and implementing policies and establishing appropriate institutions for STI are an area of priority for all governments (Verharen, et al., 2014). It is against the above background that many African governments since the mid-1990s have been preoccupied with the issue of the STI policy making exercise, starting with the formulation and/or review of their national STI policies (Martin, 2012). By 2016 at least 30 African countries had adopted explicit STI policy frameworks. The African regional Economic Communities (RECs) such as the East African Community (EAC), the Economic Community for West African States (ECOWAS) and the Southern African Development Community (SADC) as well as the African Union (AU) have also designed protocols with STI policy statements. African countries have also subscribed and/or ratified international programmes and treaties that require them to adopt domestic STI policy measures (AOSTI, 2013).

The above process involved the formulation, implementation, monitoring, evaluation and revision of policies. The process was knowledge-intensive as it required specialised skills and was dependent on evidence gathering during the formulation phase (Mugabe, Scientific and Technology Capacity Development: Needs and Priorities, 2000). The research and analysis on STI policy development has evolved from 1950 to the early 2000s. Ever since, that period, there has been a mushrooming of programmes and institutes dedicated to STI policy analysis and increased development of capacity at postgraduate level in Science, Technology, Engineering and Mathematics (STEM) in Europe, the United States of America (USA), Latin America and Asia (Kraemer-Mbula & Sehlapelo, 2016) & (Martin, 2012).

In Africa, despite the growing attention to STI policy; skills and expertise for evidence gathering and policy analysis are still in very short supply. According to AOSTI (2013) and Mugabe (2000) departments and/or ministries of science and technology as well as other agencies of governments across Africa lack the critical capacity for STI policy. They also lack the capacity to understand the complexity policy of STI. This is evidenced by the observation that governments or recognised authorities take time to promote the development, use and regulation of scientific research and technological innovation. They also take time to adapt the science for policy approach that measures the procurement and use of science in and or / for policy-making, as a tool for nations to attain national economic competitiveness.

The other important parameter high on the African agenda in the consideration of the demand for scientific evidence and advice in informing the STI policy-making process is governance (Kraemer-mbula & Wamae, 2010). Therefore, governance of science, technology and innovation plays a major role in dealing with the increasing complexity of the science and society discourse in Africa and globally. This is so as it has become a regular study query by academics and public policy makers (Bara, 2016). Furthermore, governments need to ensure that during the formulation of STI policies, transparency and accountability prevails to guide the implementation and overcome social and economic challenges such as diseases, hunger, and the wellbeing of its citizens (Hooli, 2016; Nyiira, 2006).

Mugabe (2000) states that “ordinary citizens have rights to participate in the choice of science and technology, innovation policy mission statements and in decision-making on how technological innovations are to be regulated”. The AU agenda 2063 identifies Food and nutrition, shelter and human settlements as basic human rights in most African countries and thus states have constitutional obligations to invest in STI that generates food and food security (Bartels, Ritin, & Andriano, 2016) and (Mugabe, 2000). This is emphasized in the AU Science, Technology and Innovation Strategy for Africa 2014, 2024 (STISA 2024) designed to present STI as a cross cutting sector that have an impact on the critical economical and developmental sectors such as agriculture, energy, environment, health, infrastructure development, mining, security, housing and water among others (AOSTI, 2013).

Both Namibia and Botswana are categorized as developing countries that are faced with socio-economic problems like poverty, unequal distribution of wealth, income disparity and unemployment, which warrant the development of evidence-based innovation policies to address these challenges (WorldBank, 1999). However, the existence of the policies only, does not guarantee competitiveness but rather measuring implementation processes accompanied with knowledge diffusion of adapted new technologies and of course innovative renegotiation of contracts with Multinationals engaged in extracting natural resources in these countries (Lundvall, Joseph, Chaminade, & Vang, 2009; Archiburgi, Howells, & Michie, 1999 ; Edquist . , 2009).

The question to ask therefore is as follows: if the two countries have similar challenges and natural resources endowment, then why is Namibia lagging behind Botswana in economic competitiveness ranking and the global innovation index? Firstly, the study will interrogate further how the implementation of innovation policies takes place; interview different key players; explore their functions, the composition of the implementation committees and the role they play in the National System of Innovation promotion in Namibia and Botswana. Secondly, the role Science Technology and Innovation (STI) plays in transforming raw materials into wealth and thirdly, looking at what strategies should be put in place to enhance science, technology and innovation in Namibia and Botswana (Archburgi *et al*., 1999; Porter, 1990).

These questions are of paramount importance to both Namibia and Botswana for comparative purpose because they have almost the same natural endowments in the form of mineral exports; animal husbandry and wildlife & tourism as major contributors to economic advancement. The study will investigate reasons for the anomaly and recommend strategies and best innovation policy measures Namibia needs to adopt to have a national system of innovation that is comparable with Botswana (Lundvall , 2007). Finally, the purpose of this study is to compare Botswana and Namibia's national systems of innovation for economic competitiveness using the parameters as derived from the established research thematic areas generated from the research questions of the study.

1.2 Statement of the problem

Data from the World Economic Competitive Index of 2015 report ranks Botswana at 71 and Namibia at 85, whilst in the Global Innovation Index of 2015 again Botswana is ranked at 90, which is higher than Namibia, ranked 107 out of 141 (WIPO, 2015). However, the empirical data collected during the study made it difficult to analyse the efficiency of NISs though the data was helpful to compare Namibia and Botswana NIS well it still served as a limitation to the current study.

This situation is worrisome for Botswana and Namibia as countries which over the years have developed innovation polices modelled on open innovation at macro level, whose adoption by firms and government agencies at operational level has not been well implemented (Chisamba & Kasandra, 2012 and Mugabe, 2009). Therefore, the study was necessary to investigate disparities in rankings on the World Economic Forum and the Global Innovation Index reports and confirm these anomalies, using their overall performance, national economic competitiveness the implementation of innovation policies for Namibia and Botswana (WIPO, 2015). Namibia is still faced with a phenomenon where its unprocessed low technology raw materials are exported raw when compared to Botswana whose innovation system is linked to its global value chains policies, advocating for local value addition on raw materials e.g. the diamonds mined in Botswana are processed at the De Beers Diamond processing plant which was relocated to Gaborone from London (Landvall *et al*, 2006).

The study used the complexity theory in comparing the two National Systems of Innovation for national economic competitiveness by reviewing the implementation of innovation policies and how they contribute towards the development and diffusion of new technologies and knowledge between the two countries (Frenken, 2006; Lundvall *et al*, 2009). Extensive literature searches made on Namibian library catalogues and on the Web managed to identify and retrieve only two similar studies carried out in Namibia by Hooli in 2016, but the study`s focus was on indigenous knowledge systems in Namibia.

Studies done by Hooli (2016) and Lopez (2014) attest to the scarcity of studies on how innovation policies help countries to attain economic competitiveness. Jauhiainen & Hooli, (2017) in their study on indigenous knowledge and developing countries' innovation systems posited how the inclusion of IK in the development of an IS using the DUI mode of innovation is indeed helpful. The above is true because the integration of Indigenous Knowledge (IK) at entry levels of developing an IS, supports the evolvement of a local context of IK that helps to integrate alternative grassroots initiations into Innovation Systems (IS) through the application, adaptation and modification of knowledge to suit the current or intended environment.

The application of the Doing Using & Interacting (DUI) mode of innovation in developing an STI based IS requires proper coordination to avoid a situation where the mode fails the suggested IS from attaining competitiveness (Jauhiainen & Hooli, 2017). The advantage of the DUI mode is that it is more open and even allows the participation of local inhabitants who often do not have formal education and advanced competencies in the development of a national

IS. This results in enhanced ownership among the local populations as the governance of the processes, the operationalization of the IS and the participation of stakeholders becomes of crucial importance.

However, Hooli (2016) did not look at the entire innovation system of Namibia but focused on adaptability, transformation and complex changes for Namibia and Tanzania: resilience and innovation system development from a local community perspective. The study delves more into indigenous knowledge systems and the implementation of the Southern Africa Innovation Support Programme (SAIS) in Namibia (Hooli 2016).

Secondly, the study was able to retrieve a similar literature on the study done by Bartels *et al.*, (2016). The study did a comparative analysis for the effectiveness and efficiency of national systems of innovation of Ghana and Kenya measuring the strength of linkages among research institutions and the production systems (*ibid*). The present understanding of innovation systems for national economic competitiveness is therefore based on research carried out in OECD countries and hence the need for this study (Martin, 2012; OECD, 2005b). The study sought to fill a gap in global literature on National Systems of Innovation between Botswana and Namibia. The findings would help improve Botswana and Namibia policy frameworks on Science, Technology and Innovation.

1.3 Research Questions

The main research question for this studywas: What are the characteristics of Namibia’s and Botswana's Innovation Systems for National Economic Competitiveness?

The specific research questions for this study were:

1.3.1. What are the key characteristics of an effective National System of Innovation?

1.3.2. To what extent have Namibia and Botswana implemented their innovation policies?

1.3. 3. To what extent has science, technology, and innovation (STI) contributed to Namibia and Botswana`s material base and wealth?

1.3.4. What challenges have been encountered by Namibia and Botswana in implementing their science, technology and innovation policies and strategies?

1.3.5. How can Namibia and Botswana improve their science, technology, and innovation strategies?

1.3.6. What challenges have been encountered by Namibia and Botswana in implementing their science, technology and innovation policies and strategies?

1.3.7. How can Namibia and Botswana improve their science, technology, and innovation strategies?

1.4 Significance of the Study

This study has both practical and academic importance. Firstly, it provides solutions to questions constantly asked by academics and policy makers on how to customize this concept of National System of Innovation, which is modelled on knowledge-based economies to an African situation and build National System of Innovations for national economic competitiveness. Secondly, the study will contribute to the body of knowledge by generating literature and close the knowledge gap on the application of the innovation system concept to resource-based economies like Botswana and Namibia. Lastly, the study will improve the science, technology, and innovation policy framework for and strategy implementation for Namibia and Botswana.

1.5 Limitation of the Study

The findings of Lopez (2014) and (Chinsembu, *et al.*, 2012) points at limited studies published on innovation policies. Therefore, the methodology and research design of this study targeted a specific audience which might pose a challenge to the potential generalization of results due to less published studies for comparison (Lopez, 2014). Furthermore, though the research identified the non-existence of research on innovation systems, as a methodological limiting gap to the study, this limitation was seen as a theoretical strength to conduct this study for the purpose of closing this knowledge gap and generate new literature by studying the science, technology and innovation policy regimes for Namibia and Botswana as identified by these scholars (Lopez, 2014) and (Chinsembu *et al.*, 2012).

The contribution of STI to Namibia and Botswana material base and wealth is economically undesirable so far. This problem arises from the way in which most of these STI related policies are designed and implemented (UNESCO, 2013; UNESCO, 2016). For example many graduates from universities in science and mathematically-oriented sciences like Agriculture, biology, IT, Physics and Chemistry to mention but a few are forced to change from science to non-science professions because the industry where these graduates are supposed to operate is underdeveloped, forcing them to change to careers in social science related qualifications like accountancy, law and management, which leads to them getting executive positions in public and private sectors (NCRST, 2014 ; Ministry of Finance & Develoment Planning, 2007).

1.6 Delimitation of the Study

The purpose of this study was to compare Botswana and Namibia's national systems of innovation for economic competitiveness, using the parameters as derived from the established research thematic areas generated from the research questions of the study. The study was confined to the geographical boundaries of Botswana and Namibia. The population comprising of respondents sampled from the three categories namely: the policy level, operational/agency level and the research and technology development/implementers were interviewed. Furthermore, the study made recommendations of best practices to be followed by Botswana and Namibia in developing evidence based STI polices that supports innovation systems for economic competitiveness.

1.7 Research Ethics

The study was carried out in line with ethical principles of integrity and respect of the respondents' dignity in accordance with the University of Namibia's Research and Ethics Policy. In order to ensure conformity with the provisions of the University Research Ethics Policy and regulations, the researcher made ensure that all questionnaires sent to the respondents in both quantitative and qualitative studies were accompanied by statements of intent where an assurance was given to the respondents that the information and data collected would be used solely for the research and the respondents would have open access to results once published to ensure confidentiality.

In order to address the issue of bias resulting from the fact that the researcher is an employee of UNAM, where most respondents to the study were sampled, the researcher adopted the principle of the self-imposed morality mode of according respondents their rights throughout the interviews, whilst observing the key principles of ethics such as ensuring anonymity, confidentiality and informed consent by not using names of the respondents in the study but rather using codes as unique identifiers. The data gathered during the study is being kept in a lockable cabinet for period of five years and will thereafter be disposed of in conformity with the University of Namibia rules and guidelines by shredding.

1.8 Definitions of key terms used in the study

1.8.1 Competitiveness

According to (Ferihna & Ferriera, 2017) Competitiveness is defined as a set of institutions, policies and factors combined to determine the level of productivity of an economy and its corresponding capacity to generate wealth and return on investment and to determine the potential for the economic growth of a nation. The following are key components of competitiveness: institutions, infrastructure, conducive macroeconomic environment, health system and primary education, higher education and training - including vocational education, the efficiency in supplying goods and services, market sophistication, efficient labour market, financial development and management, technological readiness, level of development, economies of scale, and the level of business and innovation sophistication. Following the above, skills and capacities, needed to be developed to enable companies to innovate in the global marketplace and to remain competitive over their rivals in designing, inventions, and developing a state-of-the-art supply chain management system of selling new products.

1.8.2 Competitive Advantage

Porter (1990) defines Competitive Advantage as a superiority gained by an organisation over its competitors in providing the same value of a product or service at a lower price or a higher price when differentiated and valued added. Furthermore, Shahamansouri, Esfahan & Niki (2013) defines Competitive Advantage using earlier definitions of Adam Smith and Ricardo as being the unique position an organisation has against its rivals regarding the efficient use of resources, it most widely allows the organisation to perform better than its competitors. It is that which the competition cannot easily simulate as well as the organisation's ability to provide products and services to satisfy its customers better than the competition would otherwise (Shahamansouri, Esfahan, & Niki, 2013).

1.8.3 Diffusion of Innovation

According to Rogers (2003) diffusion of innovation is defined as a process in which innovation is communicated through certain channels over a period, among many social systems that allow participants to create and share information of new products and ideas. Further, Rogers posits that adoption of innovation to reach its intended recipients through diffusion where the four elements i.e. innovation being adopted, communication channels are used in the diffusion, time taken for the diffusion and the social systems is needed to realise such diffusion.

1.8.4 National Economic Competitiveness

The world economic forum (2015) defines national economic competitiveness as an ability of firms or nations to be able to offer products and services that meet quality standards of local and international markets and attain competitive advantage over their competitors.

1.8.5 Entrepreneurship

Drucker (2007) defines entrepreneurship as the ability and willingness of organisations to develop, organize and manage business ventures characterised with innovation and risk taking for a purpose of making profit and increasing competitiveness in the global marketplace. Timmons (2000) defines entrepreneurship as the process of creating or seizing an opportunity and pursing it regardless of current controls such as bearing the risk of the venture and the reward in the form of profit if it succeeds.

1.8.6 Evidence based science, technology, and innovation policies

Bartels *et al.,* (2016) defined evidence-based science, technology, and innovation policies as a set of policies developed based on felt needs of society; rather than perceived needs where scientists and policy makers give quality evidence-based advice, suggest opinions and possible options that will guide the initial development and implementation of the policy.

1.8.7 Industrial Policy

According to Warwick (2013) Industrial policy is horizontal in nature and aims at securing framework conditions favourable to industrial competitiveness. Warwick further defines the rationale that industrial policy has evolved from the traditional approach based largely on product market interventions such as production subsidies, state ownership and tariffs. It has moved to a focus on interventions that help build systems, create networks and develop institutions. Furthermore, to align strategic priorities against factor markets like R&D

incentives, training subsidies, investment allowances and help with access to finance. This evidence emerges in the new trends of thinking around the application of both theoretical and practical roles of governments in implementing industrial policies.

Industrial policy is a country's strategy for economic development that promotes the growth of the manufacturing sector, informal sector and small & medium enterprise development with an emphasis on value addition and local business development. Also, a country's industrial policy is seen as an instrument that guides the process of transforming the economies from low value resource-based to high-value manufacturing through technological innovation and entrepreneurship. These policies were in use by many countries since the end of the Second World War where the focus was primarily on the promotion of new infant industries and protection of indigenous industries from competition from advanced and developed countries (Audretsch, Falck, Heblich, & Lederer, 2011).

1.8.8 Industrialisation

In this study industrialisation is defined as a process of transforming a nation that solely depends on labour intensive sectors like agriculture to adopt mechanization strategies in the production of goods and services and boost the manufacturing sector (Ministry of Industrailization Trade & SME Development, 2012a).

1.8.9 Indigenous Knowledge System

According to (Shapi, et al., 2012) IKS is defined as knowledge developed and practiced by a community for a purpose of ensuring its preservation and that it appreciates its value, with the aim of transferring it from generation to generation. On the other hand, WIPO defines IKS as being synonymous to Traditional Knowledge (TK). In other words, as a living body of knowledge passed on from generation to generation within a community. It often forms part of the people or ethnic grouping, cultural or spiritual identity. In this study the terms IKS and TKS will be used interchangeably (Shapi, et al., 2012). Furthermore, Hooli and Jauhiainen (2017) defines IK as knowledge possessed by local communities in developing countries. This knowledge is geographically specific and originating from traditions, cultures and passed through generations of continuous adaptation to changing circumstances and how they preserve and utilise this knowledge to meet current and future challenges.

1.8.10 Innovation

Innovation is a key word commonly used when defining NSI and NEC of Nations, hence many scholars have produced different definitions of the latter. In this study innovation is defined as the processes by which countries, governments, firms, and institutions put into practice systems that facilitate or enable product designs and processes (be they management or manufacturing) that are new to them and transformation of inventions into marketable products (Blankley, Scerri, Molotja, & Salooje, 2006).

According to the Oslo Manual of the OECD, innovation is defined as the implementation of a new or significantly improved product (good or service), or process, new marketing method, or a new organisational method in business practices, workplace organisation or external relations (OECD, 2005a). This definition encompasses a wide range of possible innovations, starting with the minimum requirement being that of the product, process, marketing method or organisational method must be new (or significantly improved) to the firm. This includes products, processes and methods that firms are the first to develop and those that have been adopted from other firms or new geographical locations.

Furthermore, the Oslo manual further defines innovation in sub themes to suit the business context of innovation like market innovations, product innovations, process innovations and organisational innovations (OECD, Guidelines for collecting and interpreting innovation data: Oslo Manual, 2005a) are further elaborated in the text below:

> "Innovation takes place within and is supported by a country's NSI through its components which include government, industry and finance, academic and research institutions, civil society and their environment. Innovation in the private sector is important in boosting economic growth and contributes to the quality of life. While some innovations are a result of R&D, many innovations by the enterprises also happen without R&D activities aimed at producing new or improved products and/or processes. Therefore, the strength of the NSI depends on the relationship between and linkages and interactions between players and stakeholders" (OECD, 2005a).

Many countries in the world have several public programmes support for R&D and innovation in place, with the aim which are aimed at stimulating the development of high-level human resources, as well as research output and innovation, which in turn grows and diversifies the economy (OECD, 2005b).

There are many types of innovation that can be developed by enterprises in the industrial and services sectors, where changed or improved versions of products or processes are introduced to the market. Innovation comprises of several types of activities and expenditure. A firm can make many types of changes in its methods of work, its use of factors of production and the types of innovation output that improve its productivity and/or commercial performance (Audretsch, Falck, Heblich, & Lederer, 2011).

According to the Oslo Manual, there are four types of innovation that encompass a wide range of changes in a firm's activities, namely; product innovations, process innovations, organisation innovations and market innovations (OECD, 2005a):

Product innovation relates to significant changes in the capability of goods and services and includes the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses (Edquist, 1997) and (Balzat, 2006). This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics (Balzat, 2006).

Process innovation is the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software.

A product/process innovative firm is one that has implemented a new or significantly improved product or process during the period under review (Balzat, 2006). Market innovation is the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing. Marketing innovations are aimed

at better addressing customer needs, opening new markets, or newly positioning a firm's product on the market, with the objective of increasing the firm's sales.
The innovation (new or improved) must be new to the enterprise, but it does not need to be new to the industrial sector or market (Balzat, 2006).

Organisational innovation is the implementation of a new organisational method in the firm's business practices, workplace organisation or external relations. Organisational innovations can be intended to increase a firm's performance by reducing administrative costs or transaction costs, improving workplace satisfaction (and thus labour productivity), gaining access to non-tradable assets (such as non-codified external knowledge) or reducing costs of supplies (Lundvall, Joseph, Chaminade, & Vang, 2009).

According to Balzat (2006) defines Innovation as a process of introducing new or improved products, production techniques and organisational structures, as well as the discovery of new markets and the use of input factors to increase productivity and improve competitiveness. Finally, Ezell & Atkinson (2010) defines innovation as the improvement of existing products, services, and processes as well as the creation of entirely new products processes, services, including organisational models that drive countries' economic growth.

1.8.11 Knowledge Based Economy

The OECD (2005a) describe a Knowledge Based Economy as a trend where advanced economies tend to rely much on knowledge, information, and high skills as a tool to attain competitiveness. However, Powell and Snellman (2004) defines a Knowledge Based Economy as one that is based on production and services and knowledge-intensive activities that contribute to an accelerated pace of technical and scientific advance. They further put emphasis on the reliance on intellectual capabilities of providing evidence from patent data to document an upsurge in knowledge production and show that this expansion is driven by the emergence of new industries rather than on physical inputs or natural resources. This is so as knowledge is a greater resource to raise productivity and competitiveness.

1.8.12 National System of Innovation

The study adapts Freeman's definition of NSI as cited in (Lundvall, Joseph, Chaminade & Vang, p.4, 2009) as a network of institutions in both public and private sectors that interact and initiate the process of diffusion, innovation & adaptations of new technologies as a guiding definition to have a clear understanding of the topic. This definition is further supported by other authors as illustrated in preceding paragraphs.

Patel & Pavitt (1994) and Metcalf (1995) defines NSI from the aspects and the characteristics that lead to the effectiveness and efficiency of NSI for economic competitiveness. These characteristics can be looked at as a set of distinct institutions which jointly or individually contribute to the development and diffusion of new technologies and knowledge, which provide a framework with which governments need to implement policies that influence the innovation policies for NIC (Metcalf, 1995; Patel & Pavitt, 1994).

According to (Edquist, 1997) a national system of innovation (NSI) is defined as a network of public and private institutions that are organized through linkages to relate to each other as elements of a collective system of knowledge creation and utilisation, technology development and innovation (introduction and diffusion of technology). Furthermore, (Edquist, 1997) classifies these institutional actors in the NSI as being universities, public R&D institutes, policy-making bodies, private enterprises, financial institutions, such as commercial banks, and technology support agencies such as bureau of standards. Therefore, for it to be effective, the NSI is supposed to be an open system characterised by inflow and outflow of knowledge, information, skills, and machinery. The study also makes use of Balzat (2006)'s definition of NSI. Balzat uses the crucial elements of an NSI namely (1) the consideration of the entire innovative process, (2) the analysis of various actors involved in the processes by outlaying the linkages that exist between the actors and how they influence the innovative outcome. (3) Looks at NSI as an institutional setup and as a framework and how they influence each other in the development, adaptation, and diffusion of innovation in a given country for economic competitiveness. In this study the terminologies of National System of Innovations and national systems of innovation was used interchangeably.

1.8.13 Science, Technology, and Innovation policy

Mugabe (2009) defines a national science, technology, and innovation policy as a regime of many policies with causes of action or decisions that are agreed upon by governments to cover at least four interrelated domains: science policy, technology policy, Industrial policy, and innovation policy. While, Geuna, Salter & Steinmueller (2003) defines a national science technology and innovation policy as measures or decisions national authorities take to promote the production of scientific knowledge, the utilisation of the knowledge for the production and development of technologies for spreading into the economy. Furthermore, the authors identified two clusters STI policies are concerned with starting with: priority setting of national R&D priorities and establishing mechanism and infrastructure. Secondly, STI policies concerned with the financing of technology development and diffusion of technologies, innovation, and related knowledge into the economy.

1.8.14 Science Policy

Science Policy is about measures that a government adopts to guide the choice of national research and development priority setting and establishing mechanisms for a R&D funding framework and supportive scientific infrastructure accompanied by a good incentive system for research and development (AOSTI, 2013).

1.8.15 Technology Policy

Technology policy deals with the range of actions or policy measures that are used to promote the development (the translation of scientific knowledge into hardware and/or software), prospecting, choice, procurement, diffusion, transfer, regulation, use and management of technologies. Technology policy instruments largely focus on specific technologies e.g. biotechnology, nanotechnology, and Information and Communication Technologies (ITCs). They are thus often aimed at promoting or governing a technology or a cluster of technologies. While science policy is concerned with R&D, technology policy aims at fostering technological change (AOSTI, 2013).

1.8.16 Innovation Policy

Innovation policy includes a range of actions or decisions that promote the introduction or implementation of a new or significantly improved product or process or practice into an economy or enterprise/firm. An innovation policy is largely aimed at enabling the entry of technology or knowledge, embodied in practices into an economy or market. It creates linkages between and among knowledge and technology producers with the consumers (market). A good innovation policy aims at improving a country's abilities to harness and utilise the *existing or available* pool of scientific knowledge (AOSTI, 2013).

1.8.17 Sustainable Development

According to Kates, Paris & Lelserwitz (2013) Sustainable development is defined as a type of development intervention geared towards meeting present needs whilst maintaining a balance on economic, social, and environmental limitations. This should be done without compromising the ability of future generational needs with limited resources and quality of product and services.

1.8.18 Triple Helix Systems

According to Ranga and Etzkowitz (2013), a Triple Helix System of innovation is defined as an analytical framework that synthesises the key features of triple helix interaction of state, business, and academia into the innovation system. Furthermore, Etzkowitz (2008) defines the Triple Helix model as a useful tool for studying the knowledge based innovation systems by looking at the interaction of university-industry-government and how they accommodate the dynamic overlay of exchange relations that feeds back to their institutional arrangements, how the model of national systems of innovation behaves in the evolutionary economics and how these partners in the relationship differ in modes of integration, differentiation and conceptualization of its components into the system.

1.8.19 Value Addition

Value addition is defined as a process of changing a raw commodity to produce high quality and valued products. Furthermore Nyaungwa (2013) defined value addition as a measure of the amount of value increase at each stage of the production process along the entire value chain.

He supports his argument by applying the definition to the value chain analysis of semi-precious stones mined by small scale miners looking at activities performed at each stage, from prospecting, mining & extraction methods, cutting & polishing, marketing, and manufacturing of the final product. However, value addition is an important tool in the value chain analysis because, it also helps to identify new input by products that could be used to manufacture other products apart from the original intended products, and thus ensuring a zero-emission initiative is maintained throughout the value chain.

1.8.20 Mixed Methods Research

According to Creswell (2014) Mixed methods research (MMR) is a type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research methods. This would be done with the objective of giving a breadth and depth of understanding and collaboration which uses a pragmatic worldview approach in gathering quantitative and qualitative data. In this case the design would be sequential in nature, allowing the researcher to establish assumptions that collecting diverse types of data, best provides a more complete understanding of a research problem than either quantitative or qualitative data alone.

1.9 Organisation of the Dissertation

This dissertation is divided into six chapters as presented below:

Chapter One is divided into 7 sections with section 1 dealing with the introduction to the study which gives an overview of National Systems for economic competitiveness broadly and then narrowing down to the selected countries of comparison. Section 2 then presents the statement of the problem which guides the researcher in determining the appropriate research questions or objectives to address the research problem. Section 3 presents the Research Questions. Section 4 presents the significance of the study, section 5 presents the limitation to the study, Section 6 Presents the definitions of key terms used in the study and section 7 presents the Research ethics.

Chapter Two presents an overview of innovation policies in the two countries. The chapter is divided into four sections: Section 2.2 discusses the concept of National System of Innovation. Section 2.3 presents an overview of innovation policies in Namibia. Section 2.4 provides a discussion and overview of innovation policies in Botswana. The conclusion is presented in section 2.5.

Chapter Three reviews the literature and other related issues as studied by many scholars on comparative studies and the impact of NSI in developing economic competitiveness. Literature review starts with a research paradigm to guider the reader. Furthermore, the review of the theoretical literature was guided by the research themes generated from the research questions. Lastly, the chapter presents theoretical aspects and models of national systems of innovation, objectives of (NSI) for national economic competitiveness for Namibia and Botswana, followed by a review of empirical literature from similar studies on the six themes generated from the research questions, looking at their relevance, type of methodology used, key findings and recommendations for future studies.

Chapter Four discusses the methodology used to carry out the study. This is followed by Chapter five which is sub divided into two sections. Section one discusses the empirical findings from the study and section two presents the results.

Chapter Six was divided into three sections with section one presenting the conclusions and contributions to the body of knowledge. Policy recommendations are presented in section two and section three presenting areas for further studies.

CHAPTER TWO: AN OVERVIEW OF INNOVATION POLICIES FOR NAMIBIA AND BOTSWANA

2.1 Introduction

This chapter presents an overview of innovation policies in the two countries. The chapter is divided into four sections. Section 2.2 discusses the concept of National System of Innovation. An overview of innovation policies in Namibia is presented in section 2.3. Section 2.4 provides a discussion of an overview of innovation policies in Botswana. The conclusion is presented in section 2.5.

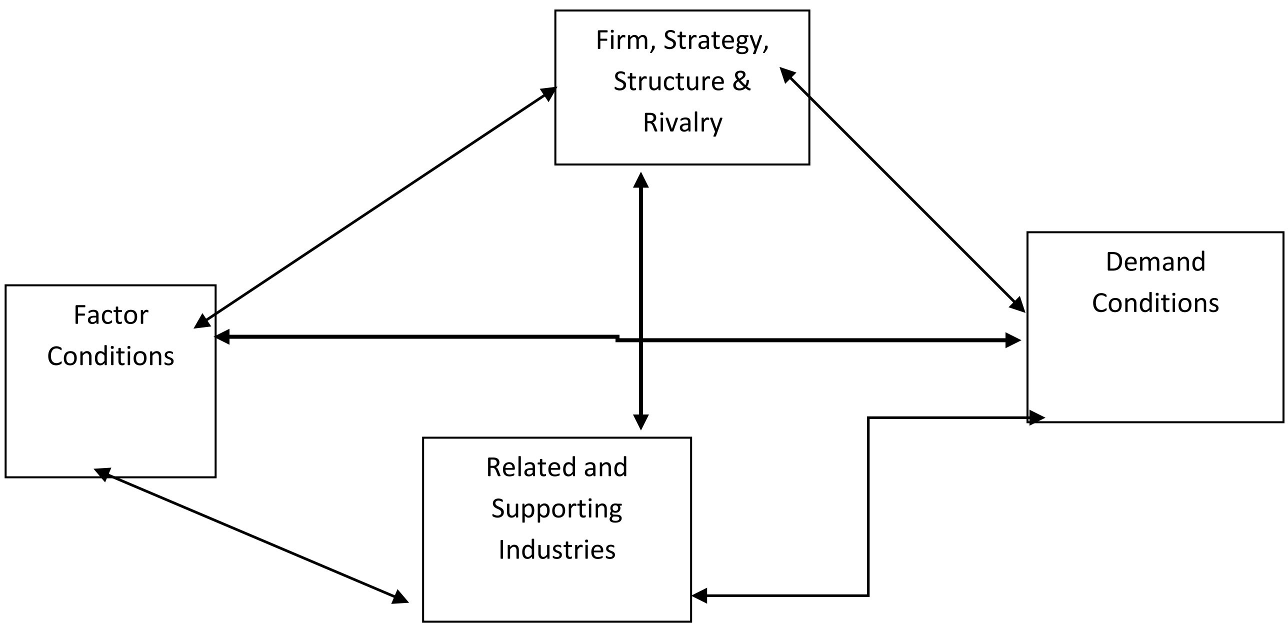
2.2 National Systems of Innovation

The evolution of NSI dates back to the Schumpeterian and Friedrich List era where innovation was used as a critical tool in the development of new technologies that lead to the introduction of new methods and processes of addressing the factors of production and implementation of new changed products or processes to intended users and the market (Mytelka, 2016).

This was triggered by raising unemployment levels in Europe due to high growth industries development after the post war era (Audretsch, Falck, Heblich, & Lederer, 2011). Policy makers had to rethink of better options to strike a balance between the increases in employment because of the industrial revolution over the maintenance of wages and keeping the living standards of employees whilst shifting from traditional labour-intensive technology industries to new knowledge-based industries (Lundvall, 2007).

Porter (1990) hinges his model of national competitive advantage of nations attaining competitiveness on the old theory of classical economists like Adam Smith and David Ricardo who posit that traditional factors of production (labour, land, natural resources, capital, infrastructure) influences the flow pattern of trade and the ability to utilise natural endowments by nations. This phenomenon leads to companies within these nations to gain a competitive advantage. From the above theory he suggests the following key determinants for national competitive advantage as presented in figure below:

Figure 2. 1: National Competitive Advantage -Porter's Diamond



Source: National Competitive Advantage Diamond, Porter, 1990

The figure 2.1 above presents the four key determinants of national competitive advantage strategy as on Porter's diamond, namely: (1) Factor conditions - which looks at the nation's ability in maximizing the use of factors of production such as skilled labour, infrastructure, and land to compete favourably in each industry. (2) Demand Conditions - on the other hand looks at the nation's ability to utilise the factor conditions demanded by the local market and industry to produce products and services that are competitive in nature. (3) Related Supporting Industries - looks at the presence or absence within a nation or international industries that supply raw materials to produce competitive products and services. For example, Namibia 's brewing industry was in the past dependent on imports of barley from Germany for its Windhoek Lager, but this has been reduced as the Namibia brewery in partnership with the University of Namibia has successfully managed to develop a variety of barley that is favourable to the Namibian climatic conditions. This variety has already been used to produce beer, and this has reduced the import of barley from Germany. (4) Firm Strategy, Structure and Rivalry - here Porter puts emphasis on a nation's role in creating an enabling environment through policy and regulatory frameworks to regulate competition and provide coordination, strategic governance through establishment structures to oversee creation, organisation and management of companies (Porter, 1990).

Furthermore, Rogers (2003) posits that adoption of innovation by NSI and their desire to see innovation reach its intended recipients, is done through diffusion, where the four elements of the topology of innovation diffusion i.e. innovation being adopted, communication channels used in the diffusion, time taken for the diffusion and the social systems needed by NSI to attain competitiveness are diffused.

Africa, as a continent is also affected by the above phenomenon experienced by Europe regarding its innovation diffusion, industry evolution and science, technology and innovation systems of which some of them are historical in nature (Teixeira, 2013). The rest are identified as weak or having no links between industry and science and technology institutions, and the existence of a mismatch between Research and Development (R&D) activities and national industrial development strategies and goals (Acemoglu & Robinson, 2012;Lundvall, Joseph, Chaminade, & Vang, 2009).

The decline in quality of Africa's science and engineering education is prompted by the low investment in science and technology by several countries (Mugabe, 2000). Furthermore, Africa is faced with a challenge of the migration of its best scientific and technical expertise to other continents and regions of the world resulting in low research output and innovation diffusion due to lack of well-equipped infrastructure aimed at advancing R&D and Innovation (Chinsembu & Kasanda, 2012).

To address this discrepancy, African leaders agreed at the Organisation of African Union summit held in Monrovia in 1979 as well as the Lagos plan of Action of 1980 and the Arusha declaration to commit 1% of their GDP towards R&D. This commitment was re-emphasized during the Johannesburg plan of Implementation adopted by governments at the World Summit on Sustainable Development (WSSD) in 2002. It was pointed out that science and technology should play a role in meeting the sustainable development goals. This would be through the application of science and technology in solving problems associated with societal challenges like energy deficiency, food security, environmental degradation, diseases, and water insecurity, sanitation, and human settlement (WSSD, 2002).

The Science and Technology Consolidated Plan of Action (CPA) calls on the international community to promote technological development, transfer, and diffusion to Innovation in Africa. Furthermore, to actively render support to African countries in their efforts to develop effective science and technology institutions and research activities, including the sharing of knowledge among Africa's centers of excellence (AOSTI, 2013).

The African Union (AU) Summit at its second ordinary session held in July 2003 in Maputo, decided to integrate NEPAD programmes into the AU structures to strengthen the commitments made by African Heads of states previously in addressing Africa's developmental challenges and opportunities. The NEPAD Secretariat through its Science and Technology Forum with assistance from UNESCO developed the CPA on science and technology.

This plan was adopted as Africa's science and technology plan at the African Ministerial Council on Science and Technology (AMCOST) held in 2005 in Dakar, Senegal. The AMCOST agreed to domesticate the CPA into Africa's Regional economic communities such as SADC, Economic Community for African States (ECCAS), Economic Community for West African States (ECOWAS), Community of Sahel-Sharahan States (CEN-SAD), COMESA, Intergovernmental Authority for Development (IGAD), Union du Maghreb Arab (UMA) for the Arab countries except Egypt which is a member of COMESA (African Union, 2014).

The SADC through its committee of Ministers responsible for Science, Technology and Innovation adopted the CPA at its meeting held in 2005 in Maputo, Mozambique and agreed to development a framework for science, technology, and innovation for the Region. Hence, the

Regional Indicative Strategic Development Plan (RISDP) calling for the harnessing of science, technology and innovation was developed to address issues the Region is facing, such as poverty eradication, prevention and cure of communicable diseases, sustainable environmental management and the provision of basic needs like clean and safe water, food, housing and safe energy (SADC, 2004).

Furthermore, the plan encourages SADC member states to develop science and technology policies and integrate science, technology, and innovation into their national development plans. Considering the above, a protocol on science, technology and innovation which calls for creation of a central coordinating system at secretariat level has been adopted by Ministers responsible for science, technology, and innovation in the Region. This was signed by the Heads of State and Government at the SADC summit held in Pretoria in August 2008. Namibia through its parliament ratified the protocol in 2010 and deposited the instruments of ratification with the SADC secretariat (SADC, 2008).

Namibia has established diplomatic or foreign relationships with many countries around the world, which facilitate cooperation in science, technology and innovation through bilateral and multilateral engagements. It has political, trade, economic and other cooperation agreements with neighbouring countries such as Botswana, Angola, South Africa and Zambia, and European countries particularly Finland and Germany as well as with the Asian countries (mainly China, Russia, India and Malaysia). Also, as a country, Namibia has signed explicit cooperation agreements on Science, Technology and Innovation with Angola, Botswana, Argentina, Mozambique, Finland, South Africa and Zimbabwe (NCRST, 2016).

Namibia is an active member of the Southern African Development Community (SADC), the African Union (AU), the United Nations (UN) system and a range of regional and international organisations and conventions. Within the SADC and AU, Namibia is engaged in various science and technology processes such as being a member of working groups tasked to develop the STISA 2014 and the SADC STI Strategy respectively.

It has ratified the SADC Science and Technology Protocol and is engaged in the African Science, Technology and Innovation Indicators Initiative (ASTII) of the AU and its New Partnership for Africa's Development (NEPAD). Through its membership of the SADC and bilateral cooperation with Finland, together with Botswana, Zambia and Tanzania, Namibia is participating in the second phase of the Southern Africa Innovation Support Programme (SAIS) II. This is aimed at supporting the advancement of science, technology and innovation, and programmes to improve the participants' national systems of innovation (UNESCO, 2016).

Within the UN system, Namibia has participated in several programmes sponsored by of the United Nations Educational, Scientific and Cultural Organisation (UNESCO) such as the review of science and technology systems in 2005 (Nyiira, 2005). Also, the review on the technical and Vocational Training, Higher Education and Innovation Policy under taken by the Ministry of Higher Education, Training and Innovation is one such initiative Namibia was involved with UN family on STI matters (UNESCO, 2016). Under the United Nations Industrial Development Organisation (UNIDO), Namibia benefited through technical assistance during the process of development of the Small and Medium Enterprise (SME) policy and the Industrial policy and Strategy (Ministry of Industrailization Trade & SME Development, 2012a).

2.2.1 Objectives of NSI

The early economists like Ricardo, Adam Smith and Schumpeter are regarded as the engineers of today's concept of national systems of innovation (Lundvall, 2007). This is evident from Schumpeter's work as early as 1934 where he urged that he saw innovation as a commercialization of new inventions and processes (Soete, Verspagen, & Weel, 2009). Their work was later improved by scholars like Lundvall (1992) and Freeman (1993) just after the industrial revolution in the UK. This was the time the UK needed to replace human labour with machinery in areas like agriculture and manufacturing. However, during and after the Second World War, industrialised countries like the USA, USSR, France, UK, and Germany capitalized on their innovative capabilities first to expand their footprints in Africa through colonization as well as exploration of Africa's rich natural endowment at the expense of local citizens. The notable success where innovative capabilities were applied was the USA in its ability to develop a defence system that led an advanced research and development leading to the evolution of computers and internet respectively (Audretsch, Falck, Heblich, & Lederer, 2011).

According to Lundvall (2007) Innovation research starting with Adam Smith who was regarded as one of the early classical economists who did tremendous work postulating how innovation was playing an important role in creating wealth for nations by differentiating the two innovation modes as stated below: "*A great part of the machines made use of in those manufacturers in which labour is most subdivided, were originally the inventions of common* *workmen, who, being each of them employed in some very simple operation, naturally turned their thoughts towards finding out easier and readier methods of performing it.*

Whoever has been much accustomed to visit such manufacturers, must frequently have been shown very pretty machines, which were the inventions of such workmen, in order to facilitate and quicken their own particular part of the work. In the first fire-engines, a boy was constantly employed to open and shut alternately the communication between the boiler and the cylinder, accordingly as the piston either ascended or descended. One of those boys, who loved to play with his companions, observed that, by tying a string from the handle of the valve which opened this communication, to another part of the machine, the valve would open and shut without his assistance, and leave him at liberty to divert himself with his play-fellows. One of the greatest improvements that has been made upon this machine, since it was first invented, was in this manner the discovery of a boy who wanted to save his own labour". This mode of innovation as suggested by Adam Smith dates back as far as the year 1776 and is referred to by Lundvall as experience-based which follows a phenomenon of the doing–using-interacting (DUI) mode of innovation.

The second mode refers to science-based research processes which Lundvall (2007) calls the STI-mode that makes science to be the first step towards technology and innovation and goes on to say that the distinctions are fundamental for analysing modern Innovation Systems as they are seen as the major mechanism behind economic growth and the wealth of nations.

"All the improvements in machinery, however, have by no means been the inventions of those who had occasion to use the machines. Many improvements have been made by the ingenuity of the makers of the machines, when to make them became the business of a peculiar trade; and some by those who are called philosophers or men of speculation, whose trade it is not to do anything, but to observe everything; and who, upon that account, are often capable of combining together the powers of the most distant and dissimilar objects. In the progress of society, philosophy or speculation becomes, like every other employment, the principal or sole trade and occupation of a class of citizens. Like every other employment too, it is subdivided into a great number of different branches, each of which affords occupation to a peculiar tribe or class of philosophers; and this subdivision of employment in philosophy, as well as in every other business, improves dexterity, and saves time. Each individual becomes more expert in his own peculiar branch, more work is done upon the whole, and the quantity of science is considerably increased by it" (Lundvall, 2007).

However, Scholars like Bartel *et al*., (20160; Hooli (2016); Metlyka (2017) & Juhinanen (2017) in their comparative analysis of national systems used different perspectives ranging from how the two innovation modes (DUI modes of innovation & STI mode of innovation) suggested by

Lundvall (2007) differs in qualitative terms to how they perform in the entire National System of Innovation for economic competitiveness. Furthermore, Porter (1990)'s national competitive advantage theory is also seen to have borrowed from the innovation systems tradition when he argued that product innovation is impacted by competition on factor production and innovation of specific sectors.

Recent work on the innovation systems by Juhaianen & Hooli (2017) indicates that the IK plays an important role in the development of innovation system frameworks as a guide to policy makers. In defining IK, it has a direct competition with standard economics when it comes to giving advice to organisations and features distinguishing the taxonomic categories are rooted in different types of micro-organisational structures.

2.2. 2 The uses of NSI

National systems of innovation are used by governments and states as vehicles to national economic competitiveness as posited by Mugabe (2009). According to Mugabe the results of the innovation surveys are relevant to direct the development agenda of nations. Many governments in Africa have noted the importance of conducting R&D and Innovation surveys for obtaining core R&D and innovation indicators that help them formulate evidence based STI policies (Mugabe, 2009; Manzini, 2013).

Key users of the R&D and Innovation surveys are policy makers. These are generally government officials who need trustworthy indicators to benchmark and monitor these policies. Researchers in the sectors of business, higher education, non-profit organisations and government also need indicators to monitor investments in research and development and to measure the research outputs in terms of publications and creation of new knowledge (Henriques & Larédo, 2012).

At the international level, the STI indicators are used for international comparisons. The NCRST in collaboration with NEPAD and ASTII compared Namibia's performance in STI with the rest of Africa and globally. The global innovation index and UNSECO compared Namibia's level of R&D and Innovation performance with the rest of the world (Muashekele, Tomas, & Sifani, 2017). The first innovation and R&D surveys conducted by NCRST served as a baseline for Namibia's national innovation indicators to be incorporated in future censuses like demographic and labour force respectively (Namibia Statistics Agency, 2016).

2.2.3 The Role of Governments

Governments play a major role in ensuring nations develop and maintain NSI that leads to economic competitiveness. Furthermore, governments or states are responsible for creating an enabling environment through development of appropriate policies and legislation that supports the setting up of STI governing structures and agencies in the form of parliamentary / portfolio committees on STI. They are also responsible for setting up National Advisory committees on STI at executive level; establishment of national STI or Innovation funds; provision of incentives and rewards to high performing researchers and innovators. They also create linkages with regional and international partners through bilateral and multilateral cooperation, ensuring the quality of national education systems according to industry demand (Lundvall, Joseph, Chaminade, & Vang, 2009).

Secondly, governments strengthen their science, technology, and innovation systems by committing themselves to international and regional instruments like the SADC Protocol on Science, Technology, and Innovation where member states agreed to spend at least 1% of the GDP on R&D by 2015. Furthermore, the AU-STISA 2024 science, technology and innovation strategy (STISA2014-2024) and the EU's (Horizon 2020) have similar declarations that are aimed at increasing R&D spending (OECD, 2004). This is done through the development of explicit targets to boost R&D expenditure by ensuring full participation of the public and private sectors in the development of effective and efficient National Systems of Innovation that are competitive. Furthermore, government should also support universities' desire of being autonomous institutions by making technology transfer a mission of universities where they collaborate with industry on contract research and student/researchers' mobility. This is as practiced by some OECD countries such as Denmark, Luxembourg and Norway (OECD, 2004) and (OECD, 2012).

2.3 An overview of innovation policies in Namibia

This section provides an overview of innovation related policies for Namibia starting with a short history of Namibia's NSI profile followed by the performance perspective of the economic, mining, agricultural and fishing sectors as presented in the sections that follow. However, before the study presents the performance perspectives of the sectors, it is important to explain the composition of Namibia's NSI and present the key explicit and implicit innovation related polices.

Namibia's NSI comprises of a policy and regulatory regime (cabinet through policy adoption & parliament through enactment of laws) with the ministry of higher education, training and innovation providing strategic governance. Also contributing to the regulatory regime are Ministries with Innovation related Policies, STI agencies responsible for R&D implantation (NCRST, universities), public and private educational and training institutions, public R&D institutes, standards compliance and quality support agencies e.g. (NSI, BIPA, NQA & NCHE). Private industrial companies (foreign large firms or multinational corporations, and small and medium enterprises), financial institutions, development banks and financing agencies (UNESCO, 2016) also contribute to the regulatory framework. Furthermore, the study provides an overview of Namibia's NSI with emphasis on key policies that contribute to the development of the NSI mentioned above.

The national research, science and technology policy (NRST) of 1999, which is regarded as Namibia's first blue-print to articulate the evolution and growth of its NSI deals with a broad array of R&D and innovation issues such as science and technology education, sustainable funding of R&D in both public and private institutions. It also deals with environmental considerations, commercialization of S&T innovations, (S&T innovation system to support entrepreneurial activities), and S&T strategies for sectoral development (education, social sciences, mining, energy, transport, indigenous knowledge systems, agriculture, water, infrastructure and health). It also promotes the protection of S&T property rights and indigenous knowledge, especially community-based knowledge systems (Government of the Republic of Namibia, 2004).

The key elements of growing an NSI are identified as follows: availability of resources (funding and human resources), institutional articulation or linkages through bilateral and multilateral collaboration and cooperation, infrastructure development (in the form of facilities, equipment and laboratories), and the overall macro-economic environment and political stability. In its objectives, the policy outlines a governance framework for coordination of STI through the creation of the NCRST and articulates its linkages with other key players within the entire Namibia NSI. Secondly, the policy talks about the establishment of an institutional mechanism for funding STI. It provides for the creation of the Fund for Innovation in Science and Technology (FIST) to be a mechanism for funding R&D, technology development and innovation activities in both public and private sector institutions. Lastly, the NRST emphasises that government developmental objectives should be achieved through a national system of innovation that has the ability to define and support a model of critical clusters of scientific institutions, technical organisations in both the public and private sector that interact in pursuit of agreed goals and objectives deemed to be strategic and important to national economic competitiveness (Ministry of Higher Education Vocational Training Science & Technology, 1999).

Going further, Namibia has in the past developed other policies that contain provisions that are intended to promote scientific research and/or technological innovation activities. These explicit policy instruments include among others: (1) Namibia Industrial Policy and its execution strategy; the Growth at Home Strategy on the promotion of value addition to local products, enhance commercialisation and develop the manufacturing sector & promote industrialisation (Ministry of Industrailization Trade & SME Development, 2012a). (2) The Agriculture Policy promotes research and innovation in the agricultural sector through introduction of new innovations in crop production such as drought animal power (weeding using oxen or donkeys in communal areas) conservation tillage and inter-cropping technologies. Furthermore, post-harvest technologies, rangeland management and value addition to animal products are some other innovations introduced in the agricultural sector (Ministry of Agriculture Water and Forestry, 2015).

There are other sectoral policies such as, mining, energy, water, public service (e-governance), forestry, information, communication & technology, education (basic, higher & vocational training), fisheries, and environment and natural resource management have explicit objectives for promoting scientific research.

Namibia 's SME policy is seen as a framework that provides an enabling environment for SMEs to innovate and contribute to national economic competitiveness as they are seen as the backbone of economic development. This is evident from results obtained from the first innovation survey conducted by the National Commission on Research, Science and Technology in conjunction with the Namibia Statistics Agency in 2014. The results revealed that innovations developed by the enterprises showed an increase in sales through the production of new products (goods and services) which favoured the development of industries (NCRST, 2016).

However, this is challenged by the fact that government support to innovation through public funding, remains low even though the rate of innovation stands at 52% of enterprises engaged in innovation. Furthermore, only one enterprise had production innovation new to the market and new to the firm. Overall innovation in Namibia follows a linear model of innovation which is more incremental, mainly characterised by a sequence of small enhancements and improvements to existing products with less value addition. However, this could be improved if government and its stakeholders within the innovation value chain can adopt better coordinated and strengthened public-private sector funding programmes that could target the kind of innovation that leads to economic growth.

The first Innovation survey findings conducted by the NCRST in conjunction with NSA revealed that R&D only was not a major driver of innovation in Namibia (NCRST, 2016). The main innovation activities according to the report were the contribution from the Namibian enterprises where more engaged in the acquisition of machinery, equipment and software which led government to introduce tax incentives to encourage the importation of the equipment and technologies. This resulted in a snowball effect to the overall economic growth, as innovation encouraged investments in the private sector, which is a key driver, known for boosting growth and contribution to quality of life (NCRST, 2016).

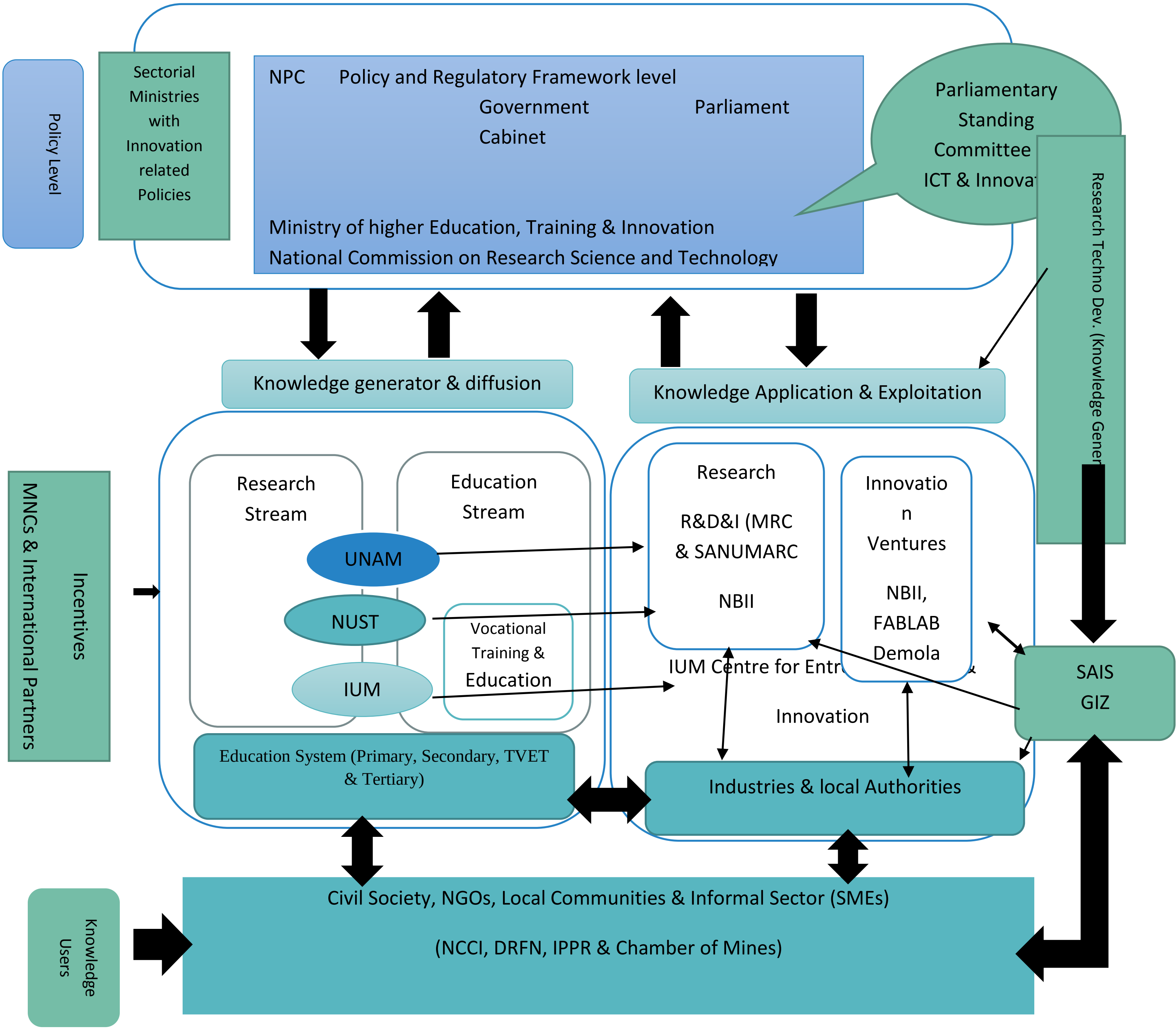
Therefore, the development of innovation policies for a National Systems of Innovation of a country like Namibia needs to adopt a triple helix model that fosters linkages between government institutions, particularly universities, public research institutes and industry

(Etzkowitz & Leydesdorff, 2000). The innovation survey findings also agree with Ezell & Atkinson, (2010) who posited that linkages and collaborations established between business enterprises and the suppliers of equipment and materials needed in commercial labs or private R&D institutes are important aspects to consider when developing policy frameworks.

This requires the involved of all three players in the model as reliance on government only, without the participation of university-industry linkages cannot stimulate these linkages as both play a vital role in promoting this partnership for economic development and diffusion of innovation (Ezell & Atkinson, 2010; Etzkowitz & Leydesdorff, 2000). The figure presented in the next page illustrates a proposed model for a National System of Innovation for Namibia adopting a triple helix model.

2.3.1 Namibia model for Innovation System

Figure 2. 2: Namibia Model for National System of Innovation

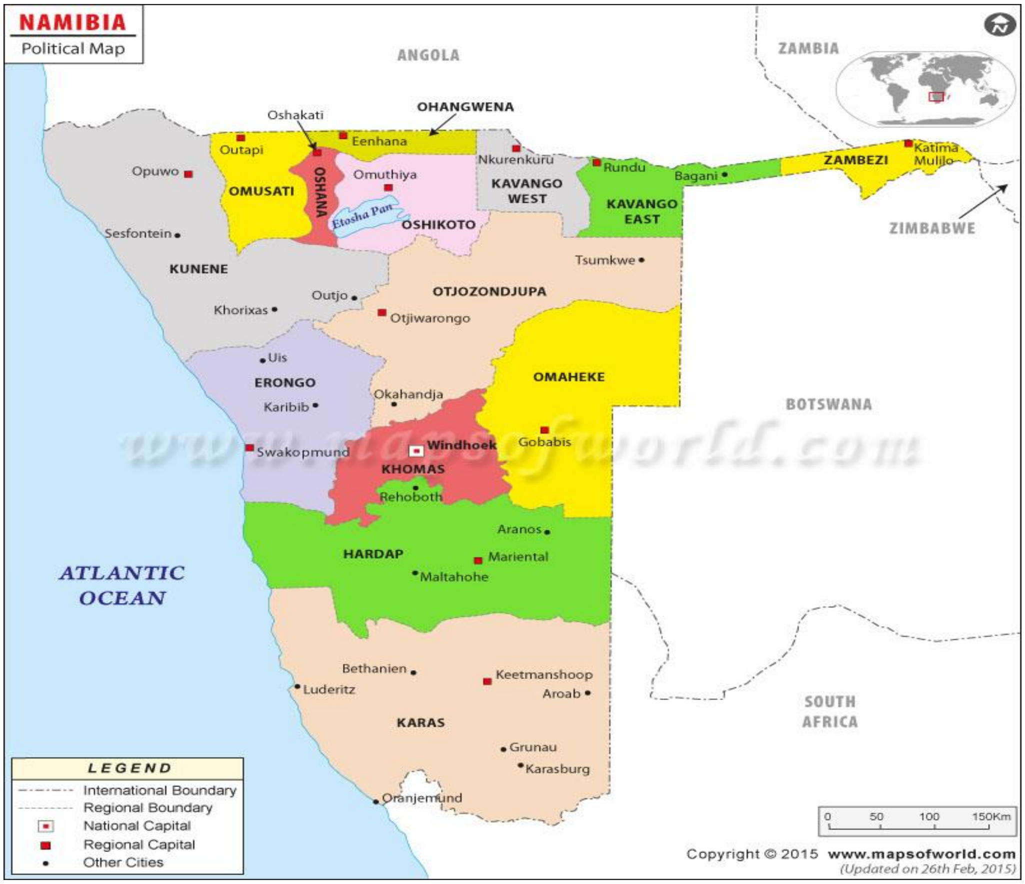


Source: Hooli & Jauhiainen, 2017

2.3.2 The Political Landscape of Namibia

Namibia is situated in the southern hemisphere situated between latitudes 17 degrees 30 seconds and 29-degree South and longitudes 12 degrees and 29 degrees East covering an area of 824 116 km^2. Namibia borders Angola in the north, Zambia and Botswana in the northeast, the south is South Africa, Zimbabwe borders on the water on the Zambezi river near Impalila Island (Mendelsohn, Jarvis, Roberts, & Robertson, 2002). It has a coastline measuring approximately 1570 Km bordering the Atlantic Ocean which is favoured by the Cool Benguela current favourable for the marine ecosystem that serve as a source for our fisheries and marine resources and alluvial diamond mining where offshore mining by DE BEERS Marine and NAMDEB is undertaken. The figure below shows the political map of Namibia with neighbouring countries indicated:

Figure 2. 3: Political Map of Namibia



Source: Atlas for Namibia adapted

On the 21st of March 1990, Namibia obtained its independence after a long battle with the racist minority rule of the apartheid South Africa, who constantly ignored the calls from international communities like the United Nations, the Commonwealth, the Warsaw Pact, the Organisation of African Unity (OAU), the Frontline States and many others to allow Namibia attain its freedom. This resistance to apartheid rule forced the South West Africa People's Organisation (SWAPO) to establish a military wing called the People's Liberation Army of Namibia (PLAN) to intensify its military operations and put pressure on the South African

Defence Force that forced to commence negotiations for a ceasefire with Namibia represented by SWAPO that led to the signing of ceasefire agreement in 1988 in accordance with the resolution 435 of the United Nations. The ceasefire paved way for the UN supervised elections held from 8-13 November 1989 in accordance with the provisions of the UN Resolutions 435 which were declared to free and fair by many observers (Mendelsohn, Jarvis, Roberts, & Robertson, 2002).

The people of Namibia voted in favour of the SWAPO party under the Leadership of Dr Sam Shafishuna Nujoma which won 42 seats out of the 72 seats of the Constituent Assembly which later became the first National Assembly on 21 March 1990. The country is demarcated into 14 political Regions headed by Governors. The following are the names of the Regions mentioned above: Erongo, Hardap, Kavango East, Kavango west, Khomas, Kunene, //Kharas, Ohangwena, Omaheke, Omusati, Oshana, Oshikoto, Otjozondjupa and Zambezi (Mendelsohn, Jarvis, Roberts, & Robertson, 2002).

The SWAPO Party was given a mandate to form the first democratically independent government whose main task was characterised by putting in place systems and development of legislation and policies that were necessary for addressing social and economic challenges faced by the people of Namibia that time. The first supreme law was the Namibian Constitution which was adopted on the 9th of February 1990 by the members of the Constituent Assembly, which later became the first parliament of the Republic of Namibia. Article 95 of the Namibian Constitution provides for the promotion and maintenance of the social welfare of the people by adopting polices and legislation aimed at improving the socio-economic well-being of the people through the provision of quality education, and the application of science and technology as a tool for development. This required a proper preservation of Namibia's ecosystem, essential use of ecological, biological diversity and utilisation of natural endowments to benefit all (Government of the Republic of Namibia, 1990). This was followed by the unification of the different Bantustan educational systems into a unified education system for all Namibians through the adoption of the education for all policy (Angula, 1990).

2.3.3 History of Namibia NSI

The management and coordination of STI at in Namibia before its independence was based in South Africa under and managed under the South Africa Council for Scientific and Industrial Research (CSIR) (Government Gazette, 1988). Namibia began discussions after independence to repel the old CSIR Act of 1988 to pave way for the establishment of a new national STI coordinating framework for the country.

The University of Namibia through its Multidisciplinary Research Centre (MRC) held the first S&T conference in 1994 to identify challenge and opportunities for S&T in Namibia. This conference recommended the establishment of a coordinating body for S&T at ministerial level. It was against this background that HIS EXECLLENCY Dr. Sam Shafishuna Nujoma, The President of the Republic of Namibia, during the composition of his second Cabinet of 1995 created a new ministry that was called the Ministry of Higher Education, Vocational Training Science and Technology (MHEVTST) in 1996 that laid the foundation for creation of Namibia's national system of innovation which first by developing the first National Policy on Research Science and Technology followed by regulatory framework and governance, strengthening of STI institutions (Ministry of Higher Education Vocational Training Science & Technology, 1999).

The first work towards the establishment of Namibia's first national system of innovation was proposed in the National Research Science and Technology policy developed in 1999, whose aim was to provide for a strategic framework and guidance for generating, producing and using scientific knowledge that helped in pursing programmes that would lead to Namibia attaining its competitive advantage in the production of goods and services (Ministry of Higher Education Vocational Training Science & Technology, 1999).

Further, the policy defines principles necessary to foster coordination within sectors as well as strategies that encourage innovation and entrepreneurship (Ministry of Higher Education Vocational Training Science & Technology, 1999). The National Research Science and Technology Policy of 1999 suggests several sets of principles and instruments to guide Namibia on how best to acquire, absorb, adapt and further apply science and technology applications needed for achieving national developmental goals such as in Vision 2030, NDP4 &5 (Ministry of Higher Education Vocational Training Science & Technology, 1999).

In the year 2004, the National Planning Commission under the Office of the President submitted to the Parliament of Namibia for approval, the Namibia Vision 2030 strategy which envisaged a Namibia which would be competitive, industrialised, a knowledge society driven by its people enjoying prosperity, peace and harmony (Government of the Republic of Namibia, 2004). The Namibia Vision 2030 strategy is a vision that is been to be implemented through five-year national development plans (NDPs) by encouraging an integrative approach that allows active participation and interaction of governments, business, local communities, NGOs, academic institutions in the development of sectorial plans (Government of the Republic of Namibia, 2004).

In the same year, the Directorate Research Science and Technology under the Ministry of Higher Education, Training and Employment Creation developed a Bill to regulate the coordination, developing & promote STI called the Research, Science and Technology (RST) Bill of 2004. This Bill was adopted by Parliament during the same year and become a law called the Research, Science and Technology Act, 2004 (Act No. 23 of 2004) to guide the development and implementation of Namibia's Innovation System Innovation development through the establishment of key institutions responsible for creation of knowledge needed for innovation, diffusion of innovation, promoting STI among its citizens and production of innovative products and processes needed by industry for market sophistication and economic competitiveness (Government of the Republic of Namibia, 2004).

One such institution created was of the new Ministry of Information and Communication and Technology (MICT) in 2004 to regulate ICT in the country. However, the coordination of innovation remained under the Ministry of Education then through its Directorate of Research Science and Technology (DRST) and this changed in 2013 when the NCRST was created as a key institution to spearhead the coordinating, promotion and provision of information for innovation-related activities. Also, other innovation activities in Namibia could be seen with the Ministry of Trade and Industry's Industrial Policy and its Implementation Strategy the "Growth at Home Strategy" that promote local value addition on home grown and local manufacturing products, support the development of SME through empowering the informal sector with incentive schemes.

At the same time the Office of the Prime Minister as the office in charge of public sector innovation have championed various initiatives that led to the development of innovation related policies to ensure efficiency and effective service delivery utilizing the implementation of the e-governance policy and strategy by ministries and agencies. This initiative have shown some positive results in improving turnaround time of acquiring services like passport, IDs, registration of birth by Home Affairs and registration of companies by the registrar of companies computerization of the electronic record management system for public service and the introduction of an integrated financial management system (Government of the Republic of Namibia, 2016a) .

The implementation of Namibia's STI policy and legal framework has been characterised by a long gestation period (from policy development to implementation) which has led to obstacles in the development of the Innovation System (IS). For example, it took six years to migrate from the NRSTP of 1999 to the enactment of the Research Science and Technology Act, 2004. This was then followed by another 10 years before the NCRST was created established in 2013 (UNESCO, 2016).

This slow implementation caused by the log gestation period mentioned above was also worsened by changes in focus on IS by the country. Even though the National Development Plans supports created framework for IS, one still found anomalies on how these plans addresses innovation issues in Namibia. For example, NDP2, the focus was on building STI capacity and strengthen STI institutions & institutional governance of STI through policies and legal framework, whilst, the third National Development Plan (NDP3) had an extensive emphasis on IS development and the commercialization of IK to reduce poverty and develop rural communities and adopting technology to produce economical viable products and services under its key thematic area on knowledge-based economy (Jauhiainen & Hooli, 2017).

On the other hand, the NDP4 for 2012-2016 had little or no mention of a National System of Innovation and the potential role played by higher education institutions in diffusion innovation and knowledge for poverty reduction and stimulating growth & development of local communities (Jauhiainen & Hooli, 2017). However, the NDP5 identifies IS, innovation related policies together with the impact of R&D created by higher education institutions more, especially the commercialization of R&D outputs as playing a potential role in attaining national economic competitiveness as well as economic growth (National Planning Commission, 2016).

Furthermore, the above cannot be easily achieved, especially if there is a disinvestment by government and its stakeholders in funding (R&D) at higher education institutions. Therefore, if they want to reach the level of Finland and Switzerland in Europe and Mauritius and Rwanda in Africa, Namibia and Botswana need to rethink their priorities by encouraging governments to increase their expenditure on R&D. (UNESCO, 2016).

The development of a knowledge-based economy and technology driven nation is an uneven and complex process which requires, among other things, the production of tacit and codified knowledge (Arocena & Sutz, 2018), the development of a National System of Innovation and the exchange of knowledge has the potential to gradually expand beyond the territory where innovation activities are being undertaken to include larger parts of the globe (Mugabe, 2009).

This is where the aspect of internationalisation and competitiveness of a country plays a major role as posited by (Mytelka, 2016). However, Chinsembu and Kasanda (2012) further argued that competitiveness and internationalisation of countries are both fuelled by the ongoing perceived or real needs for economic development in the production and exchange of goods and services.

These improvements are in return resulting in several mutually reinforced processes that support investment in R&D & technological investments, investment in education, telecommunication and causing a reduction of innovation barriers as well as increasing the financing of innovation networks whilst promoting an enabling environment for university-industry partnership (Chinsembu & Kasanda, 2012).

It is therefore important that mechanisms and indices of measuring these developments are carefully and comprehensively developed to ensure that every Namibian enjoys the benefits of a knowledge-based and technology driven nation (NCRST, 2014). There is a general understanding amongst developing countries such as Namibia, whose national economies are more strongly dependent on the level of production, distribution, and usage of knowledge as well as on how well their National System of Innovation are developed to support the process of economic competitiveness (Nyiira, 2005).

The significance of international transfer of expertise, knowledge, and technological expertise as well as specialised industries, is growing and has become an integral component of successful economies in developing countries like Namibia. Recent developments in technology, especially in information and communication technologies (ICTs) have revolutionized societies in Namibia to a great extent (Matengu, 2006).

Namibia, like other countries, aspires to be a knowledge-based economy and a technology driven nation as stipulated in the Vision 2030. The creation of a knowledge-based economy and a technology driven nation is a complex and broad process. It is not just the intensified and innovative usage of ICT or the quest for the digital economy, which incorporates the production and use of computers and telecommunication equipment. It is not quite the 'networked economy' either, which incorporates the growth and diffusion of information and communication technology (ICT) companies (NCRST, 2014).

Innovation is pivotal for the achievement of Namibia's National Development Goals. However, Namibia does not currently have an updated innovation policy framework that creates an enabling conducive environment for role players to respond to the current trends of systems of innovation. Innovation has been identified as a critical ingredient for transforming nations to be economically competitive governments that are equipped with measures and competences that help improve service delivery to its citizens (Mugabe, 2009).

It is therefore, imperative for Namibia to build an innovation system to actualize the aspirations of a being transformed knowledge-based economy as proposed in Namibia's national developmental documents like Vision 2030, the Harambee Prosperity Plan and NDP5 (Government of the Republic of Namibia, 2016a). It is against this background that the Ministry of Higher Education, Training and Innovation in 2016 approached UNESCO to assist in the scoping mission to review the TVET, Higher Education and Innovation landscape.

This review augmented the need for the development of an innovation policy that is cohesive and aligned to ensure harmonization of institutions tasked with the responsibility of management, coordinating structures and governance with clearly defined functions for easy implementation of national STI programmes (UNESCO, 2016). Furthermore, the review further identified an incoherence of policies coupled with their long gestation period, poor implementation plans, and weak entrepreneurial and innovation culture remains a barrier to job creation and economic growth and a hindrance to Namibia's NSI (UNESCO, 2016).

2.3.4 The National Commission on Research Science and Technology (NCRST)

The Government of the Republic of Namibia recognised that STI is critical for socio-economic transformation, and adopted a range of explicit policies, legislation and regulations promoting STI, hence the establishment of the National Commission on Research, Science and Technology (NCRST) in 2013 to provide for the promotion, development coordination and facilitation of the promotion of research, science, and technology (NCRST, 2016). The NCRST was mandated with the responsibility of overseeing the implementation of the Research, Science and Technology Act, 2004 (Act 23 of 2004) provisions of setting a national research agenda in the form of a National Programme on Research Science and Technology and administration of a national research science technology and innovation fund (Government of the Republic of Namibia, 2004).

Although, Namibia's national system of innovation has grown in complexity since independence, the contribution of the private sector is still lacking as public institutions seem to be dominating the research and development (R&D) landscape in terms of expenditures in R&D and personnel (Jauhiainen & Hooli, 2017; Nyiira, 2005). The recent R&D survey conducted by the NCRST revealed that Government was the biggest spender on R&D in Namibia during the 2013/14 financial year.

The government sector spent N$ 216. 6 million on R&D activities in 2014 accounting for 45.9% of the total Gross Expenditure on Research and Development (GERD), making it the largest contributor to R&D expenditure. This was followed by contributions from Higher Education Institutions that accounted for 35.0%, leaving 19.1% to business and not for profit organisations as indicated in Table 2.1 below (NCRST, 2017):

Table 2. 1: R&D expenditure by sector in Namibia 2013-2014

Sector	N$ .000	Percentage
Business enterprise	53.9	19.1
Government	216.6	45.9
Higher Education	165.2	35.0
Total GERD	471.7	100

Source: Namibia R&D survey report, 2016

Table 2.1 above indicates that government is the main funder of R&D and Innovation activities in Namibia with a 45.9 % of total R&D expenditure followed by Higher Education Institutions (35%). These institutions, however also depend much on government subsidies for their sustainability. Last on the R&D expenditure ranking are Business enterprises, taking the reaming share of 19.1%, due to low local R&D and Innovation activities as most businesses operating in the country have their R&D offices abroad (NCRST, 2016).

Namibia's National System of Innovation can be divided into three categories. The first category is that of policy and regulatory offices/ministries which comprises of the executive coordination through the Ministry of Higher Education, Training and Innovation that provides for political direction and governance. Whilst the NCRST is for the coordination and facilitation of the promotion of research, science, technology, and innovation (Jauhiainen & Hooli, 2017).

The other agency is the National Council on Higher Education (NCHE) that provides an overall coordination of the higher education system whilst the Business Intellectual Property Authority (BIPA) regulates intellectual property, patent registration and industrial design and the National Qualification Authority (NQA) ensures quality assurance and compliance of the National Qualification Framework (NQF) (NCRST, 2016).

The second category comprises of public and private educational and training institutions which include the University of Namibia (UNAM), the Namibia University of Science and Technology (NUST), The Namibia College of Open Learning (NAMCOL). Vocational Training Centers (VTCs) and Community Skills Development Centers (COSDECs), including the Namibia Institute of Mining Technology (NIMT) under the National Training Authority and other specialised tertiary educational institutions such as the College of the Arts in Windhoek, the Namibian Maritime and Fisheries Institute (NAMFI) in Walvis Bay.

There are also private universities that complement the work of Namibia's two public universities in providing degrees: MSc and PhD to some extend in the following areas Management, ICT, Education, HIV/AIDS management, Health Sciences (nursing and public health) and entrepreneurship studies. These are the International University of Management (IUM) and the Welwitschia University. On the vocational and skills development domain, Namibia has colleges like Triumphant College and Monotonic Success College filling that gap by providing courses in plumbing, hospitality, electrical installation, welding, bricklaying and software design & development (UNESCO, 2016).

The third category is that of public research and development (R&D) institutes and technology support agencies. These include the Namibia Standard Institute (NSI), the Central Veterinary Laboratory (CVL), the Multidisciplinary Research Centre (MRC), the Sam Nujoma Marine and Coastal Resources Centre (SANUMARC). The faculties or schools of Agriculture and Natural sciences, medicine and pharmacy, and engineering and IT at UNAM and the Namibia Energy Institute (NEI) that focuses on the establishment of a national information resource base for renewable energy, sustainable energy use and its management are also included in this category. Finally, there are also schools of agriculture and natural sciences, and engineering and Information Technology (IT) at NUST (NCRST, 2016).

Table 2. 2: Key Players in the Namibian National System of Innovation

Category	**Institutions**
Policy Level	Parliament (STI legislation) Cabinet (Executive role) Ministries responsible for STI, OPM, Planning & Economic, Education, International Relations & Cooperation, Industrial Relations, Labour and Employment Creation & Industrialisation, Trade and SME Development.
Operational: Agency/ Programme Level	Change agencies (NCRST, NTA, NCHE, BIPA, &NSI)
Research Technology Development level	NUST, UNAM, NBII, MRC, SANUMARC, NEI, IUM, DRFN, Cheetah Conservation Fund, Welwitschia University, Triumphant College and Monitronics College
Civil Society/ Private Sector	Namibia Chamber of Commerce and Industry, Chamber for Mines, Agricultural Union of Namibia, Non-governmental forums/ civil societies and Council of Churches

Source: Author's own compilation

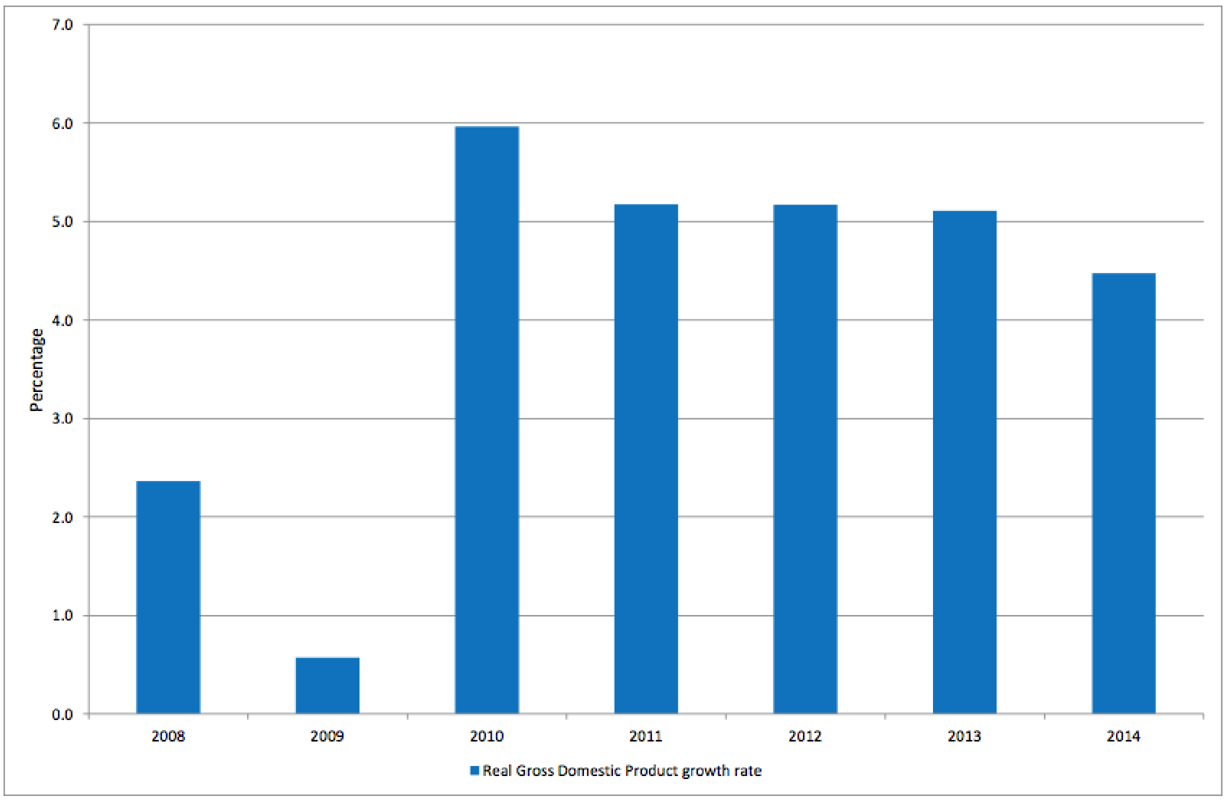
The above table presents key players in the Namibia's NIS categories as proposed by Mytleka (2016) and Mugabe (2016) in their definitions of innovation, which inspired me to proceed with the adoption of their proposed model for an innovation system as a framework for this study. This required a thorough analysis of complex and relational systems to guide the formulation of high-level policy recommendations needed for countries to attain economic competitiveness by revisiting, the goal of the study in order to align it with proposed framework (Glrobbelaar, Tijssen, & Dijlsterhuis, 2017). The sub sections that follow presents the performances of Namibia's economic, tourism, mining & energy, manufacturing, agriculture, and fisheries sectors and how they contribute to the NSI.

2.3.5 Economic Perspective

Namibia is endowed with natural resources ranging from mineral resources, marine resources, wildlife resources and scenery. Moreover, agriculture is a strategic sector in the Namibian economy, with most of the population depending on it for their livelihood (NCRST, 2016). Therefore, Namibia's economic competitiveness and industrialisation drive must be based on its comparative and competitive advantage, with an emphasis on value addition to the natural resources. The development of associated value chain initiatives by the Ministry of Industrialisation, Trade and SME Development in its quest to implement the growth at home strategy and the Harambee Prosperity Plan pillar 2 of Economic advancement are some of the initiatives that will improve Namibia's competitive ranking globally (Government of the Republic of Namibia, 2016a).

Namibia has a relatively strong economy compared to many African economies. It is classified by the World Bank and the International Monetary Fund (IMF) as an upper-middle-income country. The good economic performance is largely accounted for by good governance and political stability, fiscal discipline and favourable macroeconomic conditions. Figure 2. 4 below shows the average growth rate over the period 2011 to 2014.

Figure 2. 4: Real Gross Domestic Product



Source: Namibia Statistics Agency, 2011

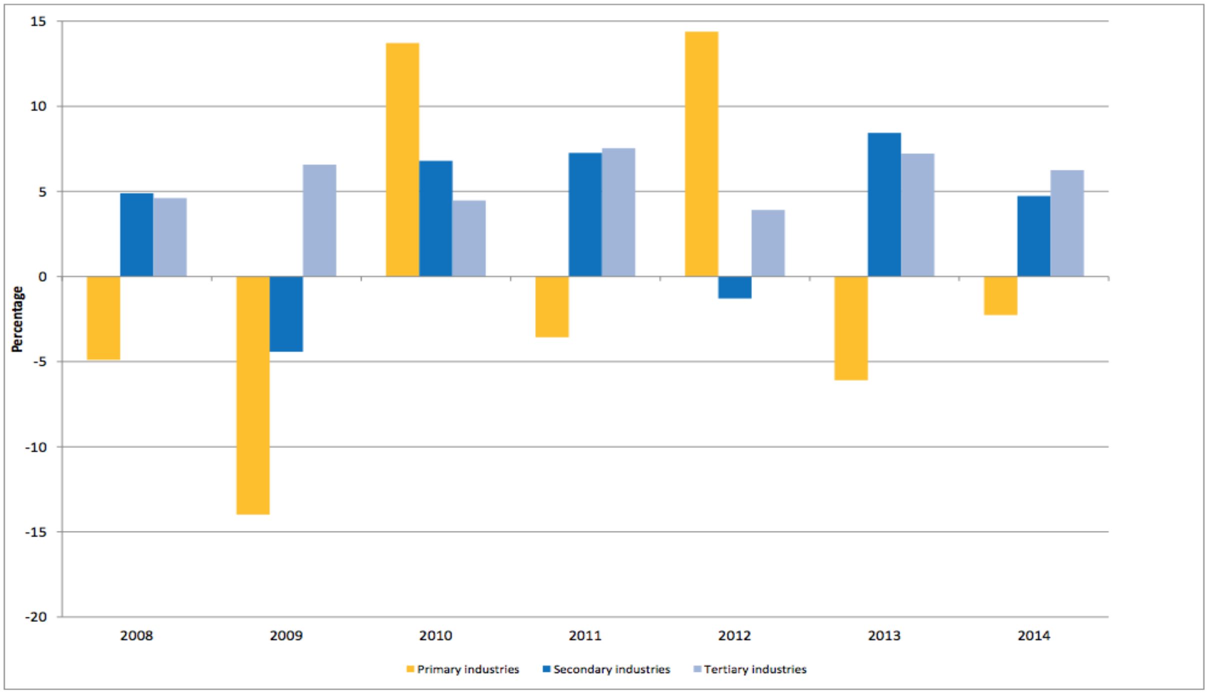
The main economic activities or sectors of Namibia are agriculture, tourism, mining and fisheries. Since independence in 1990 the economy has performed well, with an average annual Gross Domestic Product (GDP) growth rate of 4% (Namibia Statistics Agency, 2011). The economy grew at 6.4% in 2014 from 5.7% in 2013. The GDP growth was projected to be approximately 6.4% in 2016 and forecasted to be an average of 5% for the period 2015-2020. These sectors constitute or contribute about 60% of the country's GDP. The agricultural sector comprises of livestock production and employs at least 25% of the population. Mining and construction are also major sources of employment and contribute significantly to the country's GDP. The mining sector generates about N$22 billion in revenue (about 12% of GDP) and employs about 20 000 people (Government of the Republic of Namibia, 2016a).

However, the seemingly slow pace in the economic structural transformation in the Namibian economy has partly been a restraint to achieving inclusive growth and shared prosperity (Namibia Statistics Agency, 2011). There has been only a small change in the shares of the industries in GDP over the years, with the services accounting for over 50 percent of the GDP, the primary industry representing about a fifth of GDP and the secondary industry representing less than twenty percent of GDP. The services and manufacturing industries represent about 68 percent of GDP and has been stagnant over the years, falling short of the 80 percent target set in Vision 2030 (Government of the Republic of Namibia, 2004).

The growth in the primary industries shows the highest variability over the years, owing to the changes in climatic conditions and fluctuations in the international commodity markets (National Planning Commission, 2016). Furthermore, the structure of the economy's exports is characterised by commodities (representing over a third of total exports) and manufactured products predominated by mineral products with low value addition, limited to mainly cutting and polishing of diamonds, copper, and zinc refinery. Meat and fish processing are the other two main activities in the manufacturing industry. This points to an economy whose production capacity is limited, with a small and less diversified manufacturing sector. All these have resulted in a situation where most of the locally produced goods are exported while much of the local consumption demand is met by imports (NCRST, 2016).

Figure 2.5 below, presents the performance of primary, secondary, and tertiary industries to GDP over a period of 2008-2014.

Figure 2. 5: Growth Rates of (primary, secondary & tertiary industries) industries as percentage of GDP



Source: National Accounts, 2011

The figure above indicates that primary industries performed below average during the 2009/2010 financial year due to the global economic recession that affected most sectors that supplies primary industries with inputs.

2.3.6 Tourism sector

The Government of the Republic of Namibia recognised the potential of the tourism sector to the economy by the establishment of the Ministry of Wildlife, Conservation and Tourism in 1990 (Sherbourne, 2017). The Tourism Sector in Namibia is one of the key contributors to the country's GDP through revenue from tourists who visit Namibia. This necessitated the government of Namibia in 1991 to declare tourism as a one of the priority sectors. The first White Paper on Tourism was adopted by Cabinet in 1994 (Ministry of Environment and Tourism, 1994). The White Paper paved the way for the establishment of institutions to oversee the management of all government tourist establishments under the Namibia Wildlife Resort (NWR) after the passing of the Namibia Wildlife Resort Company Act in 1998 to operate and maintain the 22 tourist resorts and camp sites around the country (Government of the Republic of Namibia, 1998).

The promotion and regulation of the tourism industry was not producing the desired results until the government created the Namibia Tourism Board (NTB) as a statutory body in 2000. The NTB in conjunction with the Ministry of Environment and Tourism developed the National Sustainable Tourism Growth Strategy. The National Sustainable Tourism Growth Strategy, complemented by the National Tourism Investment Promotion Profile and Strategy, aims to transform Namibia into the most competitive tourism destination in Africa. The strategy has identified and aims to address the constraints in the sector, thus unlocking its true potential (Ministry of Environment and Tourism, 2016).

These barriers include the weak partnership between the public and private sector, lack of policy harmonisation and incentives, unavailability of vocational skills, lack of recognition of prior learning and limited inter-sectorial cooperation. Therefore, the strategic focus for tourism growth promotes private sector orientation, with the public sector providing an enabling environment such as the necessary infrastructure, training, public safety, and other support services (Ministry of Environment and Tourism, 2008).

Furthermore, the strategy emphasises the culture of hospitality and excellent customer care and marketing strategies that focus on priority markets to increase tourist arrivals and investors. The strategy further recognises the importance of sustainability through increased tourist arrivals and period of stay, reducing, encouraging geographical spread of tourists throughout the whole country, enhancing the multiplier effect of tourism. Furthermore, support programs aimed at transforming sustainable economic and social empowerment are necessary for sustainability (Ministry of Environment and Tourism, 2016).

2.3.7 Mining and Energy Sectors

The Mining sector is the main driver of Namibia's economic growth due to the availability of large deposits of minerals and metals like Gold, Diamonds, Copper, Zinc, Uranium, Manganese, and other earth metals (Sherbourne, 2017). Namibia exports diamonds, uranium ore and concentrates, and zinc to countries such as South Africa, the United Kingdom (UK), Spain and the United States of America (USA) without adding value to these minerals. This trend has put a barrier in Namibia's aspirations of growing its industrial capability and developing advanced research and innovation institutions (Sherbourne, 2017).

Integrating the mining industry with other sectors of the economy through up-stream, down-stream and side-stream linkages is critical to the structural transformation of the Namibian economy. There have been significant investments by the industry over the years, with several new mines coming on stream and expected to reach full operating capacity soon. Moreover, the Behre Dolbears report of 2015 has ranked Namibia at No. 7 as the most attractive destination in Africa for investment in the mining sector, an indication of the potential of the sector to continue to be one of the key players in the economy. Botswana on the other hand is ranked No. 8 (Dolbear , 2015).

However, the lack of value addition and minerals beneficiation remains a constraint from the country realising more significant gains from the sector. The Chamber of Mines indicates that, pending the Minerals Beneficiation Strategy (yet to be concluded), the joint value addition committee has made significant progress with the analysis of beneficiation opportunities for minerals. Attracting FDI and specialised manufacturing companies will be important in achieving the objectives of the proposed strategy.

According to Namibia's National Population and Housing Census of 2011, it is reported that most of Namibia's households, about 67.4%, did not have access to electricity due to high demand of electricity in urban areas. The high demand in urban areas is as result of infrastructure development and proximity to national grid. The opposite is true for the rural areas, most of which are remotely located. However, Namibia is a country endowed with natural energy resources including renewable ones, such as solar, wind and ocean waves and should consider the utilisation of alternative energy sources. This has prompted the Ministry of Mines and Energy to develop the renewable energy regulatory instruments in the form of the National White Paper on Energy in 2000.

The implementation of this policy was made possible with collaborative partnership with relevant stakeholders like the Namibia University of Science and Technology (NUST) through the Namibia Energy Institute on the promotion of viable solar energy technologies and UNAM's multidisciplinary Research Centre (MRC) on the wind power project in which a community of Luderitz uses the energy for their sewing project. The latter has also developed a prototype (PowerCan) patentable source of energy that could be used in areas located in the off-grid. The most constraining factor affecting the energy sector especially the renewable energy is the lack of human capacity to transform the available resources into affordable usable technologies which can supply affordable energy (Namibia Statistics Agency, 2011).

In 2000 the Ministry of Mines and Energy developed a national White Paper on Energy. The White Paper diversified the energy sources to include renewable energy resources. Under the national Vision 2030 document, renewable energy is prioritized as a major source of energy to supplement grid electricity in a country which is sparsely populated. Currently the county is battling with electricity supply shortages and the government is calling on local and international investors to invest, particularly, in the supply of renewable energy.

2.3.8 The Fishing sector

Namibia's fisheries sector is divided into two categories: Marine fisheries due their location in the central region of the Benguela current with a coastline stretching from the Kunene River in the north and the Orange River to the south. The Inland fisheries category is the second, so called from its perennial rivers (Okavango, Zambezi, Kunene & Orange) and lakes, ponds and fish farms (Sherbourne, 2017).

The Fishing Industry is currently Namibia's second largest export industry after mining, contributing about 12.8% of the exports. This contribution is triggered by the high demand of Namibian marine resources such as horse mackerel, hake and other species for export to countries like: Spain, South Africa, Democratic Republic of Congo (DRC), Italy, Germany, China, Mozambique, Portugal, Zambia and Zimbabwe (Ministry of Fisheries and Marine Resources, 2012).

Improving value addition in the fishery sector is one of the strategic objectives of the Ministry of Fisheries and Marine Resources. Therefore, value addition is one of the determining factors in allocation of fishing quotas. While there is seemingly a lot of value addition taking place in the industry, the extent of value addition to marine resources differs for the different fish species. Furthermore, there does not seem to be a value addition strategy in place (Ministry of Fisheries and Marine Resources, 2012).

2.3.9 Agricultural sector

Many African governments are facing the challenge of meeting global, international, continental, regional and national developmental goals addressing issues of Agriculture and Food Security. Namibia identifies agriculture as one of the key drivers for economic development and improvement of the social wellbeing of its citizens (FAO, 2015). Therefore, the Agriculture Sector in any given country is considered as a backbone of economic development and growth as it plays a significant role in ensuring food security that is essential for poverty alleviation. A well-fed nation is a productive nation as its citizens will have the ability to innovate through creation and exchange of knowledge, for education and training and for the promotion of creativity, cultural development and intercultural dialogue (Government of the Republic of Namibia, 2016a).

In Namibia the Agricultural sector is regarded as the highest employer with 172 530 people which makes about 27.4 % of total employment (Namibia Statistics Agency, 2016). The sector and its related industries contributed 3.7% to GDP in 2014 and experienced an increase in growth of 9.6% (Namibia Statistics Agency, 2014). However, this growth declined in the following years of 2015/2016 financial year due to drought which affected about 70% of the population who solely depend on Agriculture for their livelihood (Ministry of Agriculture Water and Forestry, 2015).

The government of the Republic of Namibia managed to deal with the drought situation of 2015/16 through the application of an innovative way of mitigating the effects of the drought. This involved the participation all relevant stakeholders from the public sector: The Office of the Prime Minister's Directorate of Emergency & Disaster Management and the National nutrition alliance, the Ministry of health and Social Services, Ministry of Land Reform, the National Planning Commission through its regional poverty profiles managed to alert the regions early enough to prepare how to mitigate drought and survive from other epidemics associated with drought. Whilst the Ministry of Urban and Rural Development, provided the coordination role in ensuring regional profiles were implemented by regional and local councils; the Ministry of Poverty Eradication and Social welfare through its food bank programme aimed at distribution of basic essential food stuffs to the needy people as part of realising the goals set in the Wealth Redistribution Strategy.

The Ministry of Agriculture water and Forestry adopted innovative measures in drought mitigation s by introducing drought resistant varieties of crops and horticulture products using and innovative technologies of less water usage in irrigation like drip irrigation. Through its agencies like the Agro-Marketing and Trade Agency (AMTA) the ministry advised farmers on the choice of crops that are drought resistant. AGRIBUSDEVE supported small scale farmers allocated plots at various green schemes; the Private sector, Non – Governmental Organisations (NGOs), the Namibian Chamber of Commerce and Industry (NCCI). Also chipping in were international agencies like the United Nations Children's Emergency Fund (UNICEF), United Nations Development Programme (UNDP), the Food and Agriculture Organisation (FAO), Red Cross Society Farmer Unions & Financial Institution (AGRA, Agribank, Namibia Agricultural Union (NAU); the Namibia Emerging Farmers' Union & the Northern Namibia Farmers' Union (NNFU) to ensure no Namibian died of hunger during the drought period of 2014-2016 (Ministry of Agriculture, Water and Forestry, 2014).

Furthermore, the Ministry of Agriculture, Water and Forestry as the custodian of agricultural development and ensuring food security in Namibia encouraged framers to use the application of innovative approaches to maximize the agricultural yields in agronomy, horticulture, and animal husbandry (Ministry of Agriculture, Water and Forestry, 2014). They did this by introducing innovative technologies that conserve the land space using a method known as conservation agriculture and through the utilisation of irrigation techniques that use less water like drip irrigation, promotion of hydroponics methods of expanding horticulture to rural farmers in areas that were predominately agronomy and animal husbandry dominated respectively.

The ministry has also managed to set up green schemes under its production agency the Agriculture Business Development Agency (AGRIBUSDEV) in the Kavango West Kavango East and Omusati regions. The produce from these green schemes are marketed by the MAWF trading arm the Agro-Marketing Trading Agency (AMTA) which has silos or grain in the Zambezi, Kavango West & East, Omusati and Oshikoto regions whilst fresh products are stored at the Horticulture hubs in Oshana and Kavango East regions respectively (Ministry of Agriculture, Water and Forestry, 2014).

All these interventions are resulting from the revised National Agriculture Policy of 1995 which culminated in the revised Namibia Agriculture Policy of 2015 that is aligned to Regional and International instruments like the World Trade Organisation (WTO) Agreement, the SADC protocol on Trade, SADC Regional Agriculture Policy, the Southern Africa Custom Union (SACU), the Dar es Salaam Declaration of Agriculture on Food Security, the revised SADC Regional Indicative Strategic Development Plan (RSIDP), the 2003 Comprehensive Africa

Agriculture Development Programme (CAADAP) and the 2014 AU Malabo Declaration on Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihood and many others (SADC, 2004; African Union, 2014; Ministry of Agriculture Water and Forestry, 2015 & FAO, 2015).

2.3.10 Manufacturing Sector

The role of the industrial policy in the process of economic structural transformation and economic development cannot be overemphasized. Namibia's industrial policy was only launched in 2012 (Ministry of Industrailization Trade & SME Development, 2012a), a situation which undoubtedly undermined the economy's industrialisation drive. The industrial policy emphasises the need to provide incentives to local industries to make them more competitive. It further stresses the need for SME development and promotion to create opportunities for the majority to be involved in productive economic activities.

Financing, skills development, innovation, research and development and regional integration are other areas prioritised in this policy. In implementing the industrial policy, the Growth at home strategy was adopted. This strategy stresses the importance of industrialisation based on Namibia's competitive advantage and the need to enhance value chains and linkages within the various industries of the economy. A strong partnership between the public and private sector coupled with improved logistics, infrastructure and ease of doing business will be necessary to create an enabling environment for this to happen (Ministry of Industralization, Trade & SME Development, 2012b).

However, the Namibian Manufacturers' Association notes that the delays in the launch of the Retail Charter and the lack of implementation of the Namibia Procurement Act of 2016 to support local manufacturers are some of the constraints to growing the sector (Government of the Republic of Namibia, 2016; NCRST, 2014).

The expansion of the manufacturing sector in Namibia will be realised if government injects more funds and creates an enabling environment for empowering the informal markets and promotes SME development. Critical initiatives needed to stimulate growth in the manufacturing sector include the transformation of the country's economy through fulfilling Namibia's aspirations of becoming a great player in infrastructure development through structural transformation, value addition in industrialisation, promotion of local procurement and realising the dream of becoming a SADC logistical hub (National Planning Commission, 2016).

2.3.11 Namibia's Performance on the Global Innovation Index

Namibia's innovation output performance is ranked with that of its peers in the SADC and Sub-Saharan African regions, namely: Botswana, Mauritius, Rwanda, and South Africa. The Global Innovation Index of 2014 ranks Namibia at No. 108 out of 143 countries. This is a slight improvement from the results of the GII (2013) report where Namibia moved one step up from No. 109 of 142 countries to the current No.108 and the country further moved to 97 in 2017 (WIPO, 2104, 2017).

The shift in the ranking could be attributed to high scores on the following innovation input pillars:

(1) Institutions (political stability, press freedom & government effectiveness).

(2) Human capital and research (high expenditure on Education as % of GDP).

(3) Business sophistication.

Low rankings were recorded in Research and Development (106), Business Sophistication (innovation linkages) (108), Infrastructure (113), Knowledge & Technology Outputs (knowledge creation, knowledge diffusion, knowledge impact) (137) as these pillars lacked baseline data (WIPO, 2016).

In 2017's Global Innovation Index, Namibia is ranked 97/127 countries with high scores under sub pillars of institutions (58) and creative outputs 75. The least score still is in knowledge & technology output with a score of Namibia GERD Performance. This performance is triggered by the growth in GERD for Namibia from 1990 to 2016 where the country recorded and increase from 0.02% in the 1990s to 0.35% in 2016 (NCRST, 2016). During the same period the country managed to increase its human resources for R&D to 750 Full Time Equivalent (FTE) of 350 are full time researchers representing 46.2% of the FTE personal.

The management of patents, industrial designs and trademarks registration has been enhanced with the establishment of the Business Industrial Property Authority (BIPA) as a State Owned Enterprise under the Ministry of Industrialisation, Trade & Small and Medium Enterprise Development (MITSEMD) which saw the reduction in the numbers of days for the processing of company registration and computerization of the registration process through online registration (Ministry of Industrailization Trade & SME Development, 2012a).

2.3.11.1 Success Factors

There are different dimensions and aspects of the knowledge-based economy but the third National Development Plan NDP3 of Namibia identifies Innovation, Economic & Institutional Infrastructure and Education, Science and Technology as key drivers for attaining a knowledge-based economy (NDP3, 2006). However, the NDP5 further points at the weak performance in innovation indicators.

Inadequate funding mechanisms accompanied by lack of equipment & facilities to support R&D and Innovation prevents Namibia from maintaining a steady increase in its GERD (National Planning Commission, 2016). This eventually leads to non-cohesion among players in the NSI, making it difficult to define the roles played by sub-systems like the contribution of departmental research to the overall university research output. This is because collaboration between policy makers, HEIs and industry is limited. In the context of a National System of Innovation, Lundvall (2007) presents the most ideal mode that clearly defines the linkages and explains the role of knowledge producers as sub systems that contribute to the overall attainment of a country's national STI vision and mission.

2.3.11.2 Cases of Best Practices

The Best Practices can be drawn from the performance of countries like Malta and Mauritius who spend more than 1% of their GDP on R&D and have developed a critical mass of skilled manpower and well-equipped R&D laboratories (WIPO, 2013). Another country that can be a case for best practice is Finland whose population size is like that of Botswana and Namibia. How it managed to move from a paper producing country through its company NOKIA to a technology leader in cell phone manufacturing, transforming the economy from a resource-based to a knowledge-based economy makes a good case study and case for benchmarking (OECD, 2005b).

South Korea is another country to draw experience from as it managed to become a leading knowledge-based economy through investment in R&D with government playing a leading role in driving the innovation on its electronics industry such as Samsung and Daewoo (OECD, 2005b).

2.3.11.3 Indicators of KBE

Namibia adopted its Knowledge based economy indicators from the Frascati and Oslo Manuals and has in the past participated in providing R&D data to the NEPAD ASTII programme (OECD, 2005a). However, the data used, based on desktop information gathered by the then Directorate of Research Science and Technology (DRST) under the Ministry of Education presented biased statistics on Namibia's KBE index. The NCRST in conjunction with the Namibia Statistics Agency commissioned the first national R&D and Innovation survey to map out the country's R&D and Innovation landscape and the following indicators were adopted as national R&D and Innovation core indicators (NCRST, 2017) by the Namibia Statistics Agency as shown in the Table below:

Table 2. 3: Namibia Core Indicators

Indicator	Value 2013/14
Gross domestic expenditure on R&D (GERD (N$ 000)	471 733
Gross domestic product (GDP) at current prices (N$ 000)	139 331 618
GERD as a percentage of GDP	0.34
Total R&D personal (HC)	1132
Total researchers (HC)	749
Total technicians (HC)	255
Total support staff (HC)	128

Total R&D personal (FTE)	570
Total researchers (FTE)	351
Total technicians (FTE)	150
Total support staff (FTE)	69
Total R&D personnel per 1000 in total employment (FTE)	0.8

Source: NCRST R&D survey report, 2016

Table 2. 4: Namibia Core Indicators (Cont'd)

Indicator	Value 2013/2014
Total researchers per 1000 in total employment (FTE)	0.5
Female researchers as a percentage of total researchers (HC)	38.7
Female researchers as a percentage of total researchers (FTE)	38.7
Total Namibian researchers as percentage of total researcher (HC)	73.3
Total employment (1000)	713

Source: NCRST R&D survey report, 2016

It must further be noted that these R&D indicators contribute towards the creation and diffusion of new knowledge, making the country innovative, competitive and gain economic growth through the appreciation of the importance of R&D and Innovation. The latter, accompanied by increased investment in R&D, funding education and infrastructure development leads to technology advancement, innovative and skilled human resources, improved productivity, economic growth, and employment creation (NCRST, 2016).

To ensure compliance with the proposed innovation indicators, Namibia conducted its first survey on innovation in 2016, using the OECD guidelines as prescribed in the Oslo Manual to come up with a set of core innovation indicators for measuring the impact of innovation from business enterprises. These core innovation indicators were used in the planning and development of an evidence based STI policy framework for Namibia. Secondly, the results of the survey are useful for policy makers, business enterprises, industry, academic & research institutions in fostering linkages needed to build a national system of Innovation (NSI).

They also help in understanding the relative innovation performance and the impact it has on various policies in creating strategic competitive advantage (NCRST, 2017).

As Namibia aspires to be a knowledge-based economy by 2030, the country needs to track its progress through benchmarking and setting of targets to improve research and innovation. In the NDP5, under the section of research and innovation, Namibia set itself ambitious desired outcomes to be achieved during the period 2017 to 2022 as shown in the following table:

Table 2. 5: Namibia Research and Innovation Desired Outcomes as Per NDP2 2017-2022

Indicator	Strategies	Initiatives
Increase gross expenditure as percentage of GDP from 0.35 to 1% by 2020	Create an enabling environment for science, technology, and innovation	Through the development of evidence based STI policies with explicit interventions for mobilization of resources and government to ensure funding channelled through centralized STI budget
Improve Namibia's innovation ranking in GII from 97 to 80 by 2020	Develop national research and innovation infrastructure	Systematic approach to increase graduates and postdoctoral fellows at national universities to increase the number of patents. Also, through the provision of adequate scientific and technological infrastructure that supports the advancement of research, innovation and development

Increase full time equivalent researcher / 1000 population from 0.5 to 1 in 2020	Build research and technical competencies	Strengthen government / university / industry partnerships to promote the sustainable culture of research, innovation and entrepreneurship in Namibia

Source: Author's own compilation adopted from National Planning Commission, 2016

Table 2.5 above shows Namibia's aspirations towards a knowledge-based economy will be achieved if its GDP expenditure is increased from 0.35% in 2016 to 1% by 2020, the country's ranking on the global innovation index should improve to the 80th position from the current 97 if it improves its time equivalent researchers / 1000 population from 0.5 in 2015 to 1 in 2020, all things being equal. Finally, all these indicators will be realised if there is adequate scientific and technological infrastructure that supports the advancement of research, innovation, and development (National Planning Commission, 2016. P. 33).

2.3.12 Namibia GII Rankings

Namibia's Innovation rankings on the GII report for 2017 was 93 out of 127 and showed high performance under the pillar of institutions with a score of 58 due to good political stability with a clean record of conducting free and fair elections every year. A good example is the political calmness exercised during general and regional elections by all political parties participating, where no reports of vote rigging and violence were experienced. Secondly, Namibia has the world's most celebrated constitution that guides development of a good regulatory environment built on the principles of the rule of law and clearly defines the separation of powers which gives three arms of the state (Executive, Judiciary & legislature) room to operate independently.

Lastly, Namibia recently enacted a procurement law that business transactions in Namibia have become more transparent. The shortened period of business registration through the development of a computerised business registration system under the Business Intellectual Property Authority (BIPA) has reduced the bottlenecks experienced in the past. Incentives introduced by the Ministry of Finance to attract foreign direct investment are one contributing factor for the high score under the sub pillar institutions.

The other sub pillar where Namibia scored 75 over 127 was in creative outputs where the key contributors are in ICT internet applications and production of creative goods / services and other intangible assets resulting from innovation and creativity that are developed most by entrepreneurs and innovators. However, the country did not perform well in knowledge output and technology with a lowest score of 123 over 127 due to weak or poor collaboration between universities and industry as knowledge created by universities might not be the right resources required be industry (Dutta, Soumitra; Lanvia, Bruno; Wunsch-Vincent, Sacha, 2017). On the technology front, Namibia is hit by economic bondage to South Africa in terms of supply of technology inputs caused by Namibian industries' heavy dependency on South Africa. Most industries and chain stores operating in Namibia are subsidiaries of Multinational Companies from South Africa where most of the R&D and Innovation happens and Namibia is at the receiving end of finished goods,

Therefore, for Namibia to improve its ranking on the GII, a paradigm shift is needed in the sub pillars of knowledge and technology outputs where the knowledge created by institutions of higher learning will have an impact on society and university/industry. Government should also collaborate in the diffusion of knowledge to generate wealth and improve the economic growth of the people.

The second sub pillars that need attention are in the development of the required knowledge workers, identification and promotion of innovative linkages and development of platforms that support knowledge absorption, (i.e. this can be strengthened through institutions like vocational training centers partnering with industries in knowledge absorption, at tertiary level, strengthening of FABLABs and NBII and learning and work integrated programmes through internship, coaching and mentoring).

2.4 An overview of innovation policies in Botswana

2.4.1 Political Landscape of Botswana

Botswana is a landlocked country with an area of 582,000km^2 and is situated in Southern Africa, sharing borders with Zimbabwe, Zambia, Namibia, and South Africa, see Figure 2. It has a population of 2.195 million people. The bulk of its landscape is covered by the Kalahari Desert with the rest of the land being savannas and plains around the Okavango delta, stretching as far as Francistown, the central regions, and the north eastern Districts of Chobe.

Figure 2. 6: Map of Botswana showing Rivers and Borders

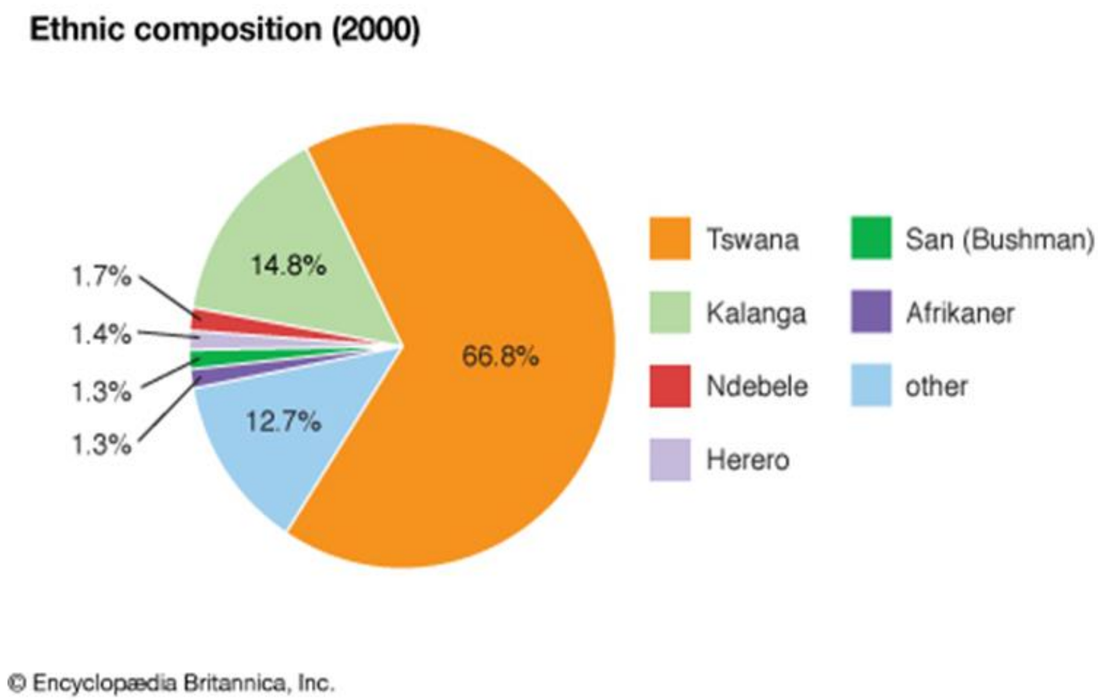
Source: Atlas of Namibia, 2002

The major rivers are the Limpopo, Molopo, Okavango, Zambezi, and Chobe. The people of Botswana are known for their strict laws on the preservation of the natural heritage and resources such as game, which attracts a lot of tourists from Europe, Asia, Australia, China, Japan, United States of America, South America including other African countries (World Bank, 2017). One of the major exports of Botswana is diamonds. Cattle farming for beef is also one major contributor to the country's GDP together with revenue from tourism (World Bank, 2010).

Formerly, known as Bechuanaland, Botswana became a British Protectorate under the leadership of King Thsekedi Khama of the Bangwato People. They were granted independence from Britain in 1966 and changed the name to Botswana. The people are commonly referred as Batswana for plural and Motswana for singular. This phenomenon was adopted to ensure that every Motswana regardless of the different ethic groupings should feel a sense of belonging to one body which is the country is called Botswana. The ethic groupings found in Botswana are the San, Bangwato, Ba Yeyi, Ba Herero, Masubia, Bakwena, Ba Khgathla, Ba Kalanga, Ba Tawana, Ba Kalahari, Ba Mbukushu, and more. From the above-mentioned groupings, the San, Ba Yeyi, Basubia, Ba Herero, Ba Tswana, Ba Kalahari, and Ba Mbukushu are also found in Namibia (Acemoglu & Robison, 2001).

The ethnic group composition shows that Tswana dominates with 66.8% followed by the Kalangas who constitute 14.8%, other tribes (Subiya, Mbukushu, Mayaeyi, and many others) claiming 12.7%, Ndebeles 1.7%, The San (Bushmen) 1.3%, Herero 1.35% and the Afrikaners claiming the remaining 1.3%. The pie chart below presents a summary of ethnic composition of the Botswana:

Figure 2. 7: Ethic composition



Source: Encyclopedia Britannica Inc

2.4.2 History of NSI in Botswana

Botswana started using advanced technology in the mining industry and meat processing for export to foreign countries as early as the 1970s. However, the first development plans did not mention explicit strategies relating to science and technology applications, development and capacity building for science and technology development. However, during the early years of Botswana's independence, its S&T research mainly came from the University of Botswana (UB), the Botswana College of Agriculture (BCA) as well as other government institutions involved in research at that time, like the Botswana Technology Centre (BOTEC) (OECD, 2005b).

In 1998, the Government of the Republic of Botswana development the first Science and Technology Policy to guide Botswana's future economic development and enhance productivity through the application of science and technology as a key driver for economic competitiveness. The implementation of this policy was done in conjunction with the implementation of the Eighth National Development Plan (NDP8) 1998-2003.

This was followed by a policy review in 2009 to align the objectives and strategies to those of Botswana's Vision 2016 and the ninth National Development Plan (NDP9) respectively. The latter proposed for the establishment of a coherent STI coordinating framework for driving research, science, technology, and innovation. This was to enable the country to respond to current global challenges facing the Batswana like HIV/AIDS, Poverty, job creation and the provision of portable water and sanitation (CSIR, 2005)

Furthermore, Botswana’s vision 2016 aspired to have attained prosperity for all Batswana by being an educated, informed nation that is innovative, prosperous and productive through the development of science and technology. To achieve the above, vision 2016 set out the following goals (Republic of Botswana, 2011):

- Technology adopted from elsewhere should be adapted to local conditions;
- Botswana will nurture and develop the innovative elements within its society and contribute to the S&T civilization of the future;
- Government should fund research or provide incentives to encourage the private sector to develop capacity in R&D
- Establishment of a National Research Council (this was later renamed as the National Commission on Research Science and Technology under the Research Science, Technology, and Innovation policy of 2011) whose mandate would be to promote, facilitate and fund research in Botswana;
- Strong capacity in scientific and engineering disciplines should be developed to provide crucial long-term support for the manufacturing sector;
- Policies should promote both labour-intensive technology and high technology.

The government of the Republic of Botswana realised the need to develop a Science and Technology policy with the guidance of UNESCO. Through the United Nations Financial System for Science and Technology for development the country developed the revised

National Research Science Technology and Innovation Policy in 2011 (OECD, 2005b). The implementation of the National Research, Science, Technology and Innovation Policy is faced with several socio-economic challenges despite major achievements in national development priorities over the last few decades, where science and technology contributed to the reduction. These challenges are well articulated in various policies like the Research, Science, Technology and Innovation Policy, 2011, Vision 2016 and NDP10. The national development priorities and challenges include economic diversification, eradication of poverty and unemployment, HIV/AIDS and the sustainable use of natural resources (CSIR, 2005).

Furthermore, Botswana, together with countries like Mauritius and South Africa have been participating in the NEPAD / African Union Science Technology and Innovation Indicator Initiative (ASTII) through conducting R&D surveys to help them identify bottlenecks and gaps in their innovation systems which would hinder the smooth determination of national R&D priority setting. This task has been a challenge since countries have different approaches to R&D priority setting (CSIR, 2005).

In many cases, science and technology in the Republic of Botswana was always not enjoying the limelight it deserves due to the absence of a dedicated ministry of science and technology. This led to a poorly organized system of national R&D priority setting processes, because STI functions were always outplayed by sector ministries where STI was ever attached e.g. when STI was part of the Ministry of Finance and Planning the major focus was finance, and economic development; later the portfolio was moved to Infrastructure, Science and Technology, still physical infrastructure and buildings dominated the portfolio. Even now with its merging with Communication, the focus is on Communication and STI comes second in terms of attention by the ministry's leadership (UNESCO, 2010).

2.4.3 Economic Perspective

Botswana's economy grew rapidly from a least developed country in the world at independence in 1966 to become one the fastest growing economies in the world, making it a middle-income country (KPMG, 2014). The speed in growth was accelerated by the discovery of diamonds. The revenue from diamonds contributes significantly in increasing the country's Gross Domestics Product (GDP) which stands at US$ 14.28 billion (Botswana Statistics, 2012).

The household Income and Expenditure survey conducted for the financial year 2002/03 revealed that minerals in Botswana dominate the economic sector contribution to GDP which is a narrow economic base of economic diversification. On the other hand, unemployment is high among the youth, estimated at 23.8% and the survey further records declining levels of poverty among women and men in urban areas compared to rural areas where there is a high proportion of people living below the poverty datum line (Botswana Statistics, 2012).

The macroeconomic projections of Botswana during the NDP 10 recorded an average economic growth of 5.9 percent, which was still below the targeted economic growth rate of 7.5 percent for full attainment of the vision 2016 objective on prosperity for all. Furthermore, it was projected that the increase in private sector participation in the economy influenced the decrease in the government deficit from P31.9 Billion as projected in the plan to P12.7 billion by the end of NDP10. This is as result of the private sector taking over the lead in creating inventions that trigger economic growth while at the same time making a reduction in government expenditure.

However, Honde (2017) suggests that industrialisation and entrepreneurship development are critical for Botswana's economy to attain a diversified economic status that could promote and guide the transformation of its primary service industries into advanced manufacturing services. The government of Botswana has responded to this suggestion through the adoption of the SADC Industrialisation policy in 2012 and the development of its industrial policy to support industrial development and value addition to increase competitiveness (Ministry of Finance & Develoment Planning, 2007).

2.4.4 Environment and Tourism Sector

Botswana is a leading country in southern Africa when it comes to wildlife conservation. This is due to strong regulations, policies and enforcement mechanisms to combat poaching and illegal hunting among the communities. Furthermore, Botswana is a signatory to various international instruments on the conversation of bio-diversity, like the Cartagena Protocol on conversation of biological diversity, Agenda 21 of Rio, the Johannesburg Plan of Action on the World Summit on Sustainable Development (WSSD), Conference of Parties (COP) on climate Change, Paris and Copenhagen Agreements on Climate change (Ministry of Finance & Develoment Planning, 2007). The Tourism and Travel sector is regarded as another source of income to the Botswana economy through tourists, employment creation by owners of hospitality outlets and travel tours in both (direct or indirect contribution), investment and trophy hunting from tourists who come to view and hunt for trophies in the national parks. It is estimated to have contributed about BWP 6.14 million which translate to 3.3. % of the total GDP in the year 2014 (Ministry of Finance & Develoment Planning, 2007).

2.4.5 Mining Sector

Botswana's mining sector is dependent mainly on Diamonds, where the country is ranked was the first in the world in producing high value of global mined diamonds produced in 2013. Secondly, Botswana is second from Russia as the world's largest diamond producer. Diamond mining in Botswana contributes to 26% of the country's GDP (Yager, 2016). Botswana also produces other minerals such as coal, cobalt, copper, gold, nickel, salt, sand and gravel, semiprecious gemstones, and silver through government maintaining an equity position of a majority shareholding in major mining companies operating in the country. The country can attract investors because of its good foreign and indusial polices that allow investors to operate on a free-market basis (Yager, 2016).

Mineral and metal products dominate Botswana's exports market where, diamonds only, make up 81% of the total exports, with copper & nickel contributing 7.1% and the remaining 1.1% taken by coal and ash products. These exports were mainly in raw form until the Government of Botswana adopted an innovative approach of gaining competitive advantage on natural endowment by establishing a 100% government owned diamond trading company known as the Okavango Diamond Trading Company to market the government portion of the diamonds mined by Debswana Diamond (Pty) Ltd a 50/50 joint venture between DeBeers Marine and the Government of Botswana (World Bank, 2017). Secondly the relocation of the former London based diamond trading company to Gaborone as well as the establishment of a sorting, cutting and polishing company was another innovative approach taken by Botswana to increase value addition and minimize the export of rough diamonds (Yager, 2016).

2.4.6 Fishing Sector

The Botswana fishing sector is divided into three categories namely: the commercial fishing where the fishermen catch fish for sale at informal and formal markets; whilst subsistence fishing is done at a small-scale using dugout canoes, gill nets and traditional manual hooks, mainly along the Namibian border in the Chobe and Okavango rivers for home consumption of the residents of Kasane, Satau and Muhembo area. Recreational fishing is not highly practiced in Botswana. Other sources of fisheries resources are from reservoir fisheries where dams supply fish for sale in flesh form or sun dried (FAO, 2007).

The Fisheries sector is dependent only of inland water sources covering an area of 23,280km^2 of the country's landmass (FAO, 2007). The main water sources being the Okavango delta as the largest, with the Zambezi and Chobe basin supplying the water for the Lake Liambezi and Chobe River respectively. The Tilapia (commonly known as bream) family of *Oreochromis andersonii, tilapia rendalli* and *Oreochromis macrochir* which are reported to be harvested at a large scale with other tilapia species like Sargochromis (*S. carlottae, S. greenwoodi, S. codringtonni*) reported to be harvested at low levels. These species are like the ones fished in the waters of Namibia on the Zambezi, Okavango, Chobe, and the Lake Liambezi.

Botswana is challenged in developing a vibrant fisheries sector, regulating its fisheries resources due to lack of policy and regulations resulting in incoherent and unfocussed guiding principles to manage fisheries development in Botswana. This is depriving the country of revenue as there will be no recreational fishers who come to Botswana to participate in fishing competitions anywhere in the country, like the way it is done in Namibia (FAO, 2007). Also, the aquaculture is not developed like in Namibia. The main factor leading to low development of aquaculture in Botswana could be attributed to costs associated with the development of the enterprise.

According to the FAO report on fisheries, in the country profile for Botswana for 2007, the fisheries sector's contribution to GPD was significantly low at 0.002% of GDP in 2002 compared to Namibia which stands at 15% of its GDP. This could be attributed to Namibia having legislative frameworks and executive governance structures in the form of fully-fledged Ministry of Fisheries and Marine Resources that govern both marine and aquaculture fisheries (Ministry of Fisheries and Marine Resources, 2012)

2.4.7 The Agricultural Sector

The Agricultural sector in Botswana covers both crops and livestock production (FAO, 2015). The crop sub-sector is mainly dominated by small scale farmers, thus continues to need assistance from government in capacity building. This would help to improve the performance of the sector and its resilience to market changes and climate change, enabling these farmers to become commercial farmers (CSO, 2010). Botswana is currently importing most of its grains (sorghum, millet and Maize) and imported even more when the grain product fell short starting in the 20th century. The country also imports fruit from neighbouring countries like Zimbabwe, and South Africa (FAO, 2015). Grain production (mostly sorghum, millet, and corn [maize]) fell short of national consumption due to persistent drought experienced in the country. Soil erosion due to dependence on traditional farming methods also contributed to reduced output. This forced the agricultural output to decline by 1.7% in 2015. Despite, the above phenomenon, the sector, applied innovativeness in the production of food such that agriculture remained a key contributor to the national Gross Domestic Product (GDP) with a modest contribution of 2.4% in 2015 (Honde, 2017).

2.4.8 Manufacturing Sector

According to the OECD (2004) many developed nations like England, the United States of America, Germany, Japan including the newly industrialised economies of the BRICS (Brazil, Russia, India, China and South Africa), Korea, Singapore and Taiwan have succeeded in growing their economies because they paid much attention and focus to building their manufacturing sectors through huge investment in R&D to support value addition and the development of critical mass of an innovative skilled labour force that drives innovation for global competitiveness (OECD, 2005b).

Botswana through its Vision 2016 has developed strategies that promote and support innovativeness in the setting up of manufacturing enterprises in different sectors of the economy. The implementation of these strategies was met with challenges of poor work ethics on the labour market, leading to low productivity and lack of innovation among the workforce, making firms to be uncompetitive with larger markets like South Africa (Honde, 2017). The contribution of the manufacturing sector to Botswana's GDP continued to fluctuate over the period of 1966 to 2012 due to over dependence on South African manufacturing industries as the main suppliers of commodities for supply to the retail sector and plant & equipment. This has been attributed to the proximity to South Africa and historical economic ties to the neighbouring country. The next table presents the contribution of the manufacturing sector to the GDP over the periods 1966 to 2012.

Table 2. 4: Manufacturing Sector contribution to GDP in Botswana

Year	1966	1975-76	1990-91	2005-06	2008	2012
Figure	5.6%	8.3%	5.0%	3.4%	6.4%	6.4%

Source: Honde (2017)

Table 2.4 above indicates that GDP increased in 2008 and 2012 to 6.4% and 6.3% due to the adoption of the Botswana Industrial Strategy and the strengthening of the Botswana Development Corporation (BDC) to have the ability to support major innovations in manufacturing industries such as the introduction of steel and glass factories in Palapye as well as the Hyundai car assembly plant (Honde, 2017)

2.4.9 Botswana's Innovation Performance

The GII report, 2017 has since recorded a notable increase in innovation performance of its countries, compared to the other achievers in the regions. In this cluster, Botswana is among the top nine economies that were ranked in the world top 100 economies. Top on the African continent was Mauritius (53rd), followed by South Africa (54th), Kenya (80th), Rwanda (83rd), Mozambique (84th) Botswana (90th) Namibia (93rd), Malawi (98th), and Uganda (99th). However, the SADC GII report rankings for 2017 still shows Botswana is ranked 89/127 countries ahead of Namibia who ranks at 97. Mauritius (64) and South Africa (57) are ranked top in the SADC region. The least ranked countries in the SADC region which trade with Botswana include countries such as Malawi (115); Mozambique (107); Zambia (124) and Zimbabwe (121).

The Botswana Innovation performance has improved constantly over the years and this can be attributed to the innovation model where science, technology and innovation is placed at the centre and plays an important influence on developing countries like Botswana. Through Science & Technology Innovation the country can improve its innovation performance on the World Economic Forum and World Innovation Index Competitiveness charts. Productivity and economic growth should also result from the application of science and technology principles in human capital development. This is regarded as a key driver, contributing to economic progression and human capital development. Furthermore, Botswana continues to register positive achievements in innovation performance indicators like institutions and marketplace sophistication, even outperforming some developed countries (Dutta, Soumitra; Lanvia, Bruno; Wunsch-Vincent, Sacha, 2017)

2.4.9.1 Success Factors

Botswana was regarded as one of world's poorest countries at independence in 1996. However, the country managed to grow its economy to become a fast-growing economy that led to its classification by the World Bank as an upper middle-income country suitable for doing business and attracting Foreign Direct Investment (FDI) through partnerships (Honde, 2017). The Country managed to achieve this status due the adoption of prudent policies and legislation that promotes political stability, zero tolerance to all forms of corruption, upholding good principles of good governance, equitable wealth distribution from its natural endowments (Honde, 2017). Furthermore, Botswana mining diamond giant Debswana's breakthrough in the negotiation with De Beers Marine's London based office to secure a 50/50 shareholding in the stake of diamonds as well as managing to convince De Beers to relocate its diamond trading company from London to Gaborone created opportunities for establishment of cutting and polishing companies which led to the reduction of the export of diamonds in raw-form (KPMG, 2014).

This was followed by the establishment of a diamond hub to oversee the value addition and the trading of the diamonds. The spinoff from this endeavour was in employment creation and skills development to the local Batswana as they had an opportunity to be employed and contribute to the growth of the economy (Ministry of Finance & Develoment Planning, 2007).

In the meat industry, Botswana managed to maximize its market share of beef exports to the European Union due to the adoption of innovative approaches aimed at addressing trade barriers by reducing levies and tariffs and ensuring compliance with EU import regulations on beef and meat products (CSO, 2010).

2.4.9.2 Cases of Best Practices

The Government of the Republic of Botswana realised the challenge and responded through the establishment of a dedicated institution to champion and create a common culture of R&D priority setting and innovation funding in the form of the National Commission for Research Science and Technology under the Ministry of Communication, Science and Technology (OECD, 2005b). In 2016 during a cabinet reshuffle the President of the republic of Botswana

H.E. Lt. Gen Dr Ian Khama Seretse Khama created the new Ministry of Tertiary Education Research Science and Technology which saw an increased visibility of STI. This was as result of its linkage to strengthen capacity for S&T and achieve sustainable economic development.

Governance of the innovation model proposed by His Excellency Lt. Gen Dr Ian Khama Seretse Khama followed combined linear modes of innovation - the doing, using and interacting (DUI) mode of innovation which focuses on learning by doing, using and interacting. It also followed the (STI) mode of innovation that focuses on promoting R&D, utilising and creating access to explicit codified knowledge through the suggested structures like the proposed Botswana National Research, Development and Innovation Coordinating Council (BNRDICC) to be chaired by the minister responsible for science and technology in recognition of the role S&T has and the potential to stimulate economic growth (CSIR, 2005).

Furthermore, the President on an annual basis chairs an innovation summit where an award on the best innovator of the year is honoured by the President as way of encouraging and promoting the development of innovation and entrepreneurship (CSIR, 2005). The latter is similar to Namibia, also the STI portfolio has always been appended to other sectors like Education, until in 2013 when the NCRST was established. This arrangement was still short lived as in 2015 a new portfolio, Ministry of Higher Education, Training, and Innovation was created seemingly with overlapping functions with the NCRST.

However, most African countries are faced with challenges of successfully driving innovation in their respective countries because they tend to place management and coordination of innovation policies in one sector ministries likes Science and Technology and Education for some countries. Innovation policies are cross cutting in nature and hosting or placing the innovation portfolio under a specific ministry is limiting the coordinating mechanisms of the policy and thus affect policy execution, making it incoherent due to the conflicts between ministries and dysfunctional communication between responsible departments.

Nyiira (2005) states that “Most countries have resorted to a committee system to coordinate and govern STI at the highest government level, chaired by the Head of State or Prime Minister: Egypt (Supreme Council of Research Centers), South Africa which is preparing legislation to elevate its National Advisory Council on Innovation (NACI) to an inter-ministerial body). In Rwanda, H.E. Paul Kagame President of the Republic of Rwanda chairs the intergovernmental council on Science, Technology, and Innovation and is actively involved in the driving of Rwanda’s Innovation and Science System. Other Examples from outside Africa are that of South Korea which a Presidential Advisory Committee on S&T has chaired by the President and as for Brazil the National S&T Council is regarded as the highest decision-making body on matters patterning to STI and Finland’s S&T Policy Council under the Prime Minister’s Office”. These models could be good cases for Namibia and Botswana to learn from when deciding on an appropriate innovation system to peruse.

2.4.9.3 Indicators of KBE

Botswana has adopted the OECD indicators for a Knowledge based economy GO-SPIN and NEPAD ASTII, the WIPO Global Innovation Index (GII) , World Bank indicators as key instruments to measure its R&D and Innovation landscape to guide its policy making

(Henriques & Larédo, 2012) and (World Bank, 2010). Botswana has participated in the African Union Innovation and Industry outlook studies carried out by OECD and GO-SPIN by UNESCO (UNESCO, 2013).

According to the global innovation index framework of 2016, a Knowledge based economy, is based on two pillars, namely; the innovation inputs and innovation outputs (Dutta, Soumitra; Lanvia, Bruno; Wunsch-Vincent, Sacha, 2017). Under the innovation input pillar, the table below indicates a series of indicators & what is measured.

Table 2.7: Innovation Inputs Indicators

Innovation inputs				
Institutions -political environment -regulatory environment -business environment	Human capital and research -basic education -Tertiary education -research & Development	Infrastructure -ICT -General infrastructure -Ecological sustainability	Market sophistication -credit -investment in R&D Trade & competition	Business sophistication -knowledge workers -innovation linkages -knowledge absorption

Source: Muashekele, Tomas & Sifani (2017)

The output innovation sub pillar as derived from section 2.3.11.3, are presented in the table below:

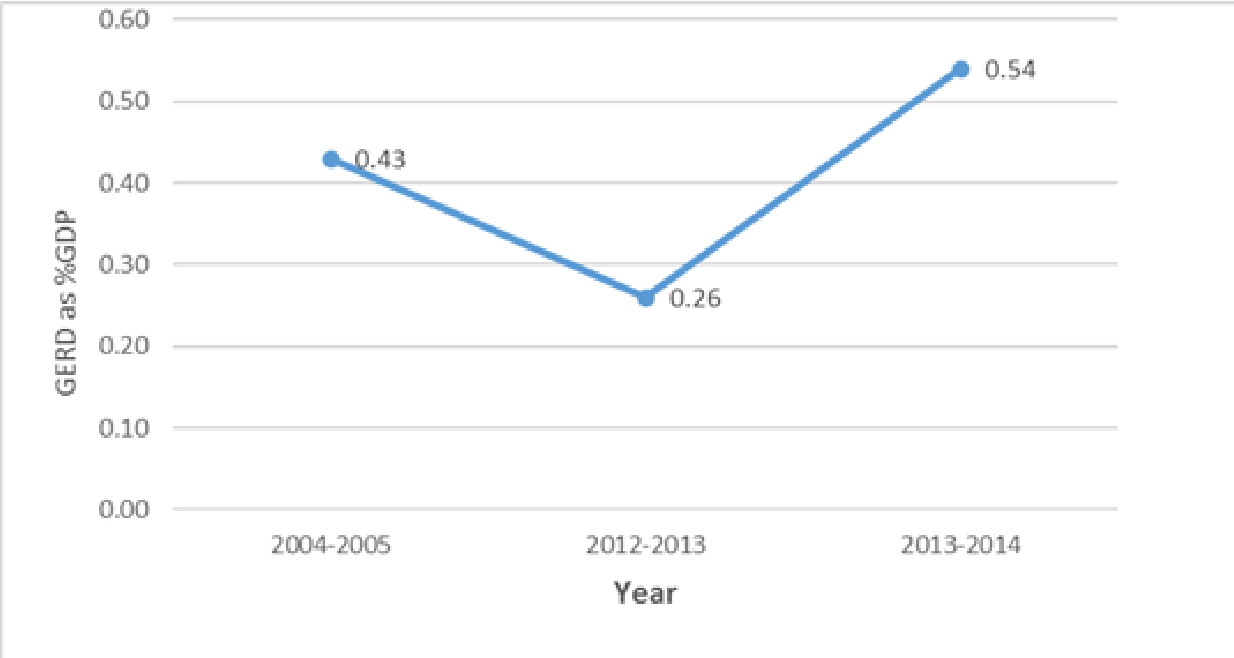
Table 2. 8: Innovation Output Indicators

Innovation output	
Knowledge and technology outputs -knowledge creation (patent application by org.); measures scientific & technology publications) -innovation linkages (university-industry research collaboration)	Creative outputs -intangible assets -creative goods and services
-Knowledge diffusion (IP & Technology Transfer and Licensing to produce economic viable goods and services)	-online creativity
-Knowledge impact (measures growth of GDP);	Labor productivity

Source: Muashekele, Tomas & Sifani (2017)

The research adapted these sub pillars as input indicators during the study when developing a national system of innovation model for Botswana. Furthermore, the indicators listed above were also used to compare the innovation performances of the two countries (Muashekele, Tomas, & Sifani, 2017).

Figure 2. 8: Botswana GERD as % of GDP



Source: National Research, Science, Technology, and Innovation Policy (2015)

The figure 2.9 above indicates Botswana's GERD percentage of GDP was 0.43% during the 2004/05 financial year and dropped to 0.26 % during the 2012/13 financial year as a result of the global economic recession, commodity markets (e.g. the Diamonds) dropped. However, GERD recorded an increase in 2013/15 to 0.54% it is still below the target of 2% set in Vision 2016. Nevertheless, Botswana's 0, 54 % GERD of GDP is higher than that of Namibia which stands at 0.35% due to the fact that Botswana has a larger R&D personnel (1716) in 2012/2013 survey (CSIR, 2005) compared to Namibia with only 1132 (Total Head Count) (NCRST, 2016).

2.5 **Summary of Chapter Two**

The Chapter presented an overview of Innovation policies for Namibia and Botswana and discussed the evolution of national systems of Innovation, followed by that of the countries under comparison. Furthermore, the chapter also presented the objectives of NSI and discussed the role played by governments in guiding NSI to remain competitive. This was followed by a detailed discussion on the contribution of key sectors in achieving national economic competitiveness and ended by pre-setting the countries' innovation performance by examining cases of best practices and success factors using KBE indicators from the global innovation index. Chapter three presents the Literature Review.

CHAPTER THREE: LITERATURE REVIEW

3.1 Introduction

This chapter presents an overview of literature review on the two countries. The chapter is divided into four sections. Section 3.2 discusses the theoretical framework by expounding on theories of NSI and what other scholars have researched on, on the six themes generated from the research questions of the study. An overview of models of NSI is presented in section 3.3. Section 3.4 provides a discussion of the empirical literature of similar studies done on the chosen topic focusing on the most recent studies, methodologies used, findings and recommending areas for further study. The summary of the chapter is presented in section 3.5.

3.2 Theoretical Literature

3.2.1 Theories on national Systems of Innovation

Scholars likes Frenken, 2006), Archburgi, Howells & Michie, (1999), (Lundvall *et al.*, 2009), Mugabe, (2009), Chinsembu *et al.,* (2012), Arocena & Sutz (2018), Edquist C. (1997), Henriques & Larédo (2012), Etzkowitz & Leydesdorff (2000), Morone & Taylor, (2010) and Lopez, (2014) posited that the determinants and variables needed for the development and adoption of evidence-based policy for an effective NSI are explained using a complexity theory. This is because the constraints experienced by Namibia and Botswana are complex and different (Frenken, 2006), (Archburgi, Howells & Michie, 1999), (Lundvall *et al.,* 2009), (Mugabe, 2009), (Chinsembu *et al.,* 2012), (Morone & Taylor, 2010) and (Lopez, 2014).

Using the complexity theory as defined by Frenken (2006) the study took cognisance of the fact that not all components of the National System of Innovation will bring change to the overall system. Frenken, (2006), like Mugabe (2009) posits that the lack of evidence-based policies on science, technology and innovation in many African countries leads to low technology readiness, risk of acquiring inappropriate technology and innovation for national economic competitiveness.

Chinsembu *et al.,* (2012) posits that knowledge is a critical resource for economic development thence the choice of an education system a country adopts has a bearing on its national competitiveness. The World Bank report of 1998 on Namibia's human capital and knowledge, identified knowledge gaps in the country's practice on STI policies implementation to attain economic competitiveness (World Bank, 1999) and (Myeltka, 2016).

3.2.2 Models of NSI

This section presents arguments by different scholars' models of NSI. According to (Lundvall B. , 2007) due to the complexity of the systems and differences in the geo-political landscape that forms up an NSI, there is no ideal model for a perfect NSI. The early traditional NSI models followed a linear model which suggests that knowledge creation takes only one direction from idea generation, research centers or institutes to production of goods and services (Archiburgi, Howells, & Michie, 1999) and (Kraemer-Mbula & Sehlapelo, 2016).

3.3.1 Characteristic of an effective NSI

According to Mytleka (2016) the main institutional actors in the NSI are universities, public R&D institutes, policy-making bodies, private enterprises, financial institutions such as commercial banks, and technology support agencies such as bureau of standards. The NSI is supposed to be an open system characterised by inflow and outflow of knowledge, information, skills and machinery.

However, the linkages in an NSI usually take different forms, including joint research projects among public institutes, and joint technology development and transfer activities between public and private sector institutions, exchange and mobility of scientists and engineers, technology licensing agreements, and sharing of information and technology infrastructure. Assessing the performance of a national system of innovation entails tracing the various institutional links and measuring the intensity of the interactions among various knowledge producers and economic actors (Mugabe, 2016). The interactions are supposed to be continuous and be characterised by positive feedback. The feedback takes place between economic firms and consumers; between R&D institutions and industry; between R&D institutions and financial ones; between policy-making bodies and R&D institutions; between policy-making institutions and private firms; and between education and training institutions and industrial firms.

The performance of NSI is also influenced by political, economic and social conditions. Open and democratic political systems are likely to encourage the search for new information, introduction of new knowledge and tend to promote learning capabilities. Institutional linkages and interactions, including positive feedback and generally the exchange of information, tends to flourish in countries where policies and political practices encourage open dialogue and debate. They flourish in countries or societies with high trust levels and strong social capital like in countries such as Finland, Singapore and Korea where NSI are driven by the highest offices of the country being either the Office of the President or the Prime Minister's Office (Fukuyama, 1995).

3.3.2 STI Policy Framework and Strategy

This section presents an overview of STI policies from both countries and explains what constituent a national science, technology, and innovation policy in the framework of a national system of innovation. Innovation systems as defined by (Mytelka, 2016) and (Glrobbelaar, Tijssen, & Dijlsterhuis, 2017) comprise of a range of interconnected structural components such as innovation actors, institutions, interactions and infrastructure that interrelate with each other.

The above definition if applied to a NIS especially the OECD adopted model will have a limitation to countries like Botswana and Namibia which are classified as developing countries. The model works well on developed countries because it describes and implements a simplified conceptualised innovation system that does not consider the government-political landscape and has less focus on economic growth. Nevertheless, scholars like Kraemer-Mbula and Wamae (2010) urges that this model can be useful to developing countries if, during the adoption and adaptation, the model explicitly integrates national activities and functions with a strong focus on learning and the development of the countries' capabilities through knowledge creation for the local context (Kraemer-mbula & Wamae, 2010).

Both countries as members of SADC, signed the SADC STI Protocol in 2008 (SADC, 2008). They actively participate in the implementation of the RISDP of SADC respectively (SADC, 2004). From these instruments, the two countries anchor their national science, technology, and innovation policy frameworks. At national level, these policy frameworks are influenced by global to national developmental challenges such as poverty alleviation, impact of the HIV/AIDS pandemic, Sanitation, and provision of portable water to communities, infrastructure development, human capital development, human settlement, employment creation and climate change.

Hence the development of science, technology and innovation policies is necessary to provide an innovative methodology of addressing these global and developmental challenges. Namibia's response was through the development of the 1999 National Research Science and Technology Policy which presented the first national S&T mission statement which sought to advance the use of science and technology in all economic sectors of the country (Ministry of Higher Education Vocational Training Science & Technology, 1999).

3.3.3 STI for wealth creation

Development of Knowledge in the local R&D capacity that is necessary to adapt, use and disseminate the new knowledge is identified as a critical tool for creating an effective National System of Innovation that creates wealth and remains economically competitive (Mugabe, 2009). A good example for above phenomenon is experience from South Korea whose GDP per capita in 1958 was like that of Ghana.

However, South Korea managed to overcome “Ghana’s” GDP per capita due to the approach adopted in investing in STI knowledge development & increased expenditure to support R&D capacity and infrastructure development. This is used as an illustration to demonstrate how investment on STI can transform a nation from a poor country to a highly industrialised knowledge-based economy that is competitive. This has led to Korea rapidly moving from a poor country to be a leading country in innovation and industrial development, with abundant knowledge workers and cutting-edge infrastructure, favourable for innovation and product development. Today Korea leads the electronic industry and motor vehicle manufacturing with its famous brand SAMSUNG in mobile phones, computers, tablets, printers, TVs, Fridges and now moving into a SAMSUNG vehicle.

3.3.4 Challenges countries face in implementation of STI policies

This section outlines the challenges faced by countries in implementing STI policies as national science, technology, and innovation (STI) policy is a regime of many policies (courses of actions or decisions that are agreed upon by government) that cover three interrelated domains: science policy, technology policy and innovation policy (Martin, 2012). Science policy is about measures (courses of actions) that a government adopts in order to: guide or determine the choice of Research and Development (R&D) priorities; establish rationales and mechanisms for funding R&D; set R&D funding and research productivity targets; establish scientific (R&D)

institutes/agencies and regulate their activities; and guide the procurement and use of science in policy processes. Overall, science policy encompasses policies for scientific research (or policy for science) and science for policy (Mytelka, 2016).

Although governments around the world have been formulating and implementing innovation policies, often through indirect measures, there has been a surge of interest and focus on direct or explicit innovation policies since the 1980s (Chinsembu & Kasanda, 2012). This interest is stimulated by the growing realization or recognition that traditional science and technology (S&T) policies who focus mainly on financing R&D and are not adequate in promoting sustainable development in general and economic transformation of developing countries. While many of these developing countries are exposed to a huge pool of scientific knowledge and technologies, they have been unable to exploit them because of limited innovation capacities (Mugabe, 2009).

It is now well accepted that in addition to S&T policies, countries require specific measures for promoting innovation—both technological and organisational. The latter type of innovation relates to the introduction of new management norms and practices into enterprises or institutions. Technological and organisational innovations co-evolve. Technological innovation tends to cause organisational change, and the converse is also true: organisational change often stimulates the introduction of new products, processes and techniques (OECD, 2012).

A national STI policy is thus about measures and/or decisions that national authorities take in order to promote the production of scientific knowledge, utilisation of the knowledge to develop technologies, and the procurement and introduction as well as the spread of both knowledge and technologies into an economy (Archiburgi, Howells, & Michie, 1999; Jörg & Branzk, 2008).

STI policy has evolved over the past six decades, particularly from the pre-Second World War era when the emphasis by nations was on how to stimulate scientific discovery to enable them better to understand of how things work which forced most governments got more concerned with the social and economic values of R&D and stimulated attention to why governments should fund R&D for purposes of technological development (Chinsembu & Kasanda, 2012;Martin, 2012). Science and technology policy emerged in the middle years of 1940 and early years of 1950 as a convergence of ‘science policy’ and ‘technology policy’, and STI policy has evolved since the 1980 (Geuna, Salter, & Steinmueller, 2003).

Overall, there are at least two clusters of issues that STI policy is concerned with around the world (Aubert, 2004). The first cluster pertains to the setting up of national priorities for R&D and directing investments towards the attainment of the specific goals within or linked to the priorities (Martin, 2012). This involves establishing funding targets, mechanisms and institutions for the R&D. Second, STI policy is concerned with measures financing of technology development and the creation of configurations of institutions for introducing and diffusing technologies and related knowledge into an economy (Ezell & Atkinson, 2010). The science policy domain started as a linear model of innovation also known as the science push and later shifted to the interactive innovation or demand pull where networking, knowledge and learning turn out to be of importance in the explanation of nation's economic growth and competitiveness (Francis & van Huis, 2016).

3.3.5 Lessons learnt on Improvement of STI Policies and Strategy

This section discusses the lessons learnt from developed economies, how they have managed to build their national systems of innovation through evidence based STI Policies, Strategies and Experiences from countries like Finland, Singapore, Malaysia, Korea, China, Japan, UK and the USA where the implementation of national policies for STI is driven by the Presidents, Prime Ministers, Parliaments through STI parliamentary standing committees and a range of other political and related executive institutions (NCRST, 2016). For example, in the United States of America, there is an established a Presidential Council of Advisors on Science and Technology (PCAST) where the President is the leader in promoting STI initiatives like the one focusing on manufacturing which President Barack Obama launched in 2011 on Manufacturing called the Advanced Manufacturing Programme (AMP) which brought together industries, universities, research institutes with a view promoting domestic manufacturing industries.

These initiatives were coordinated at a higher level with the Director of the National Economic Council and the State Secretary of Commerce co-chairing the initiative. Other similar lessons can be learnt from countries like Finland and Malaysia where the Office of the Prime Minister (PM) coordinates the design and implementation of STI policies with the Prime Minister being the patron of STI in those countries. In Africa, it is only Rwanda where the President coordinates STI policy development and implementation through the Presidential Advisory Council on STI. Botswana will follow soon with the proposed National Advisory Council on Science, Technology and Innovation in the revised STI policy to be chaired by the President of Botswana (CSIR, 2005).

Another lesson to be learnt in this study is the case of South Korea which moved from a pure dictatorial state to now be regarded as a championing proponent in actively driving innovation through the development sector-specific strategies in its industrial policy by moving from a purely dictatorial system of government to world innovation leader in flagship industries like automobiles (Hyundai, KIA motors), electronics appliances (SAMSUNG, Daewoo) shipbuilding, ICT electronics devices (Computers, laptops, cell phones and tablets) and human resources development in STI (OECD, 2005b)

3.3.6 University-Industry Linkages

Higher Education Institutions in Southern Africa have been increasingly under pressure from the general public, politicians, academics and the international donor community to become more responsive to economic and social development needs in line with new global initiatives of moving towards knowledge economies (Kraemer-Mbula & Sehlapelo, 2016). For Higher Education Institutions to overcome these challenges, there is a need for partnerships and networks with industry, research, and science councils for generating, processing, and applying new knowledge. This will require a growing emphasis within science and technology spectrum to enhance research utilisation and improve mechanisms of technology transfer to industry and public sector for improvement of living standards of communities (Glrobbelaar, Tijssen, & Dijlsterhuis, 2017)

Even though universities are known to pursue fundamental research as well as educating people, they may not provide ready-made workers that are highly competent and capable of performing in any conditions. These capacities and capabilities would ensure that the workers' capabilities are tailored to the needs of the industry. Therefore, Universities should thrive to create successful and sustainable partnership in ensuring highly skilled and competent manpower is supplied to satisfy the industrial needs.

However, research activities in universities should not be limited to areas that promise practical applications. Universities, public research organisations, and corporations all have individual roles to play in the system of national innovation, and universities are generally expected to pursue research in basic areas companies are ill-equipped to address. The role of universities is both to open up academic frontiers and to produce, across a wide range of disciplines, research results with long-lasting and large spill over effects. This study showed that if both sides are willing to work together and foster better understanding in the future, a more beneficial as well as sustainable partnership can be created (Otham & Omar, 2012; Motohash & Muramatsus, 2011).

With most public research and development (R&D) funds currently earmarked for universities and public research organisations, promoting university-industry collaborations is essential for converting this public R&D investment into industrial and economically significant innovations. Moreover, through joint research with companies, university faculty can gain a deeper understanding of R&D activities within industries related to their research interests, allowing them to develop research themes with concrete goals for innovations, such as a new product or new manufacturing process, in turn potentially increasing the likelihood that R&D activities at universities and other public institutions will lead to industrial innovations (Motohash & Muramatsus, 2011).

Lee (2000) made an assessment of university-industry collaboration by focusing on involvement of the participants, faculty members and firms and what they get out of their collaboration and further gauged whether the concept of university industry collaboration can be a sustainable element in a nation’s innovation system (Lee, 2000). Furthermore Rast, Khabiri & Senin (2012) explains that Universities are looking for new ways to remain relevant actors in the knowledge economy which means that they need to secure funding sufficient to cope with the huge costs of research and innovation. On the other hand, industrial firms are exploring ways of keeping abreast of technological progress in this highly uncertain competitive and rapidly changing environment. So, the universities can consider as one of most important partners for industry (OECD, 2004).

This partnership can be formed in different approach such as consultancy and technical service, cooperative R&D agreement, licensing, and spin –off or start-up companies. The important point to note here is that both university and industry are concerned about the success of the research (Rast, Khabiri & Senin, 2012). The Spin-off or start-up are new companies that are commercialized as university technology, research results through a license agreement (Sorensen & Chambers, 2007).

The concept of innovation is widely used in academic and decision-making circles around the world, yet its precise meaning is rarely carefully defined. In some circles, innovation is equated to research; in others, innovation is technology. It is not uncommon to come across national research and development (R&D) policy documents that bear the title of 'national innovation strategies' when in their content there is no reference to or discussion of innovation. Policymakers (and policy documents) of many governments tend to use R&D and innovation interchangeably mainly because they have not clarified these concepts in simple non-theoretical ways (Gault, 2010).

In his recently published book, Fred Gault not only defines what innovation is, but also discusses how innovation is measured and the kinds of strategies that should be instituted to promote it. Drawing on his many years of experience in developing indicators for measuring innovation in the Organisation for Economic Cooperation and Development (OECD) and in many developing countries, Gault (2010) defines innovation as ‘the creation of value from knowledge, a driver of economic growth’. The book elucidates key features of innovation: risk, non-linearity, and learning. Innovation entails taking risk. It is a non-linear process of learning to introduce a new idea or new ideas into an economic system. Innovation induces change in social and economic systems. However, the benefits and impact of innovation cannot be predetermined. Strategies for promoting innovation must take these factors into consideration.

Innovation strategies for a global economy emphasises the role of institutions and individuals in innovation. It is individuals working in firms and other institutions that ‘create value from knowledge’. In a National System of Innovation, individuals are connected and institutions are also connected (Etzkowitz, 2008). Innovation is rarely the work of a single individual working in a single isolated institution (Ledesdorff, 2005).

It is all about dynamic systems. Gault (2010) further emphasises the role of interactions among individuals, and interactions among institutions, both private and public. He discusses the role of government, civil society, businesses, manufacturing companies and other actors in nurturing innovation and building National System of Innovations. Lastly, he ends his argument by saying that “*Coordination of these activities or actions of the different actors is critical process*” (Gault, 2010). This is a challenge for many countries. Governments around the world are experimenting with different institutional arrangements or models of coordinating innovation activities and strategies. Some countries are using a centralized approach for coordination and management of innovation activities by placing the innovation policy coordinating functions in the offices of president or Prime ministers. There are also many countries where a department or ministry of science, technology or trade and industry is responsible for coordination.

Gault (2010) suggests that each country should adopt a coordination approach that is suitable to its governance situation that will about conceptual clarity to the discussion of innovation; and how to design national innovation strategies. Furthermore, a framework laid out for policymakers to serve as a guide the formulation, implementation, and evaluation of innovation strategies. Though based mainly on experiences and practices from OECD countries the discussions of how innovation strategies are developed is both rich and developing countries is relevant.

The book is a valuable contribution to the 'science of innovation policy'. Scholars of innovation and decision-makers in government and private sector will find Gault's book a source of new ideas and practical experience on designing innovation strategies to manage change in a global economy that is under increasing flux because of rapid technological advances, increasing threats from climate change and globalization (Gault, 2010).

3.3 Empirical Literature

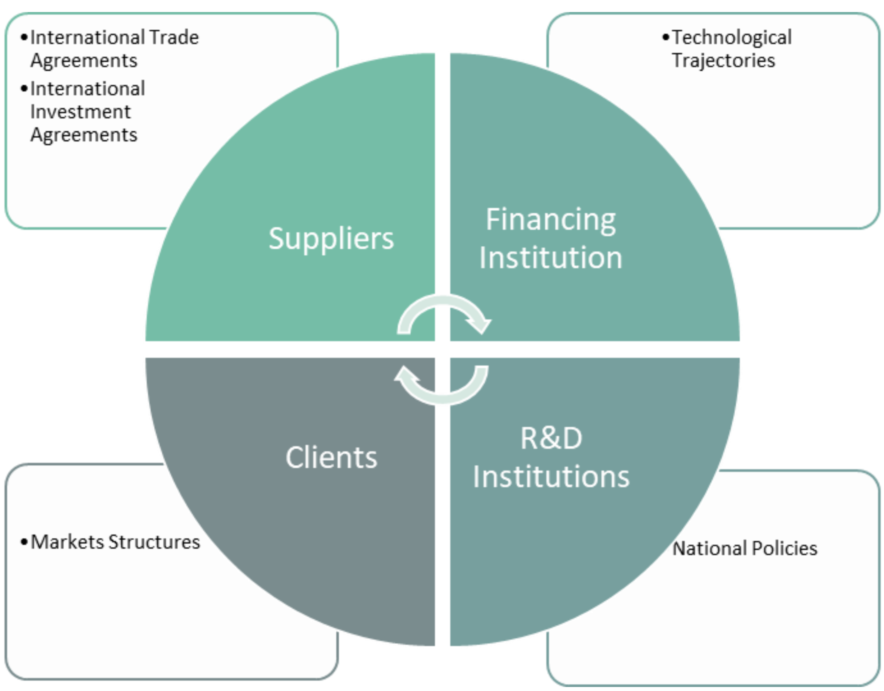
According to Teixeira (2013) the literature on the National Systems of Innovation (NSI) is a new field of research that have emerged over the past 20 years form the 1980s to 2000 where scholars like Lundvall (1992) introducing a descriptive approach grounded on theory of NSI, Nelson (1993) introduces a normative approach using empirical case studies to study NSIs and Freeman (1987) on the role played by the state in defining using lessons learnt from Japan's system of innovation (Freeman, 1987).

Bartels, Koria & Andriano (2016) carried out a research on the determinants of the effectiveness and efficiency of the Ghanaian and Kenyan systems of innovation. Their analysis on the system was to determine whether innovation is the driving force for economic development. The study looked at the importance of innovation and how to govern the fiscal and monetary policies in the economy. The study further stated that the determinants of innovation are differentiated across national economies and policy and strategies that are designed to enhance the innovation and they should be specified to each economies National System Innovation (NSI) (Henriques & Larédo, 2012).

Analysis as stated in the study relies on the regression framework of the businesses in the economy and how their research and development (R&D) and the different research institutes that are in the economy mainly the universities and other research institutes' and the industries' technological production systems (Edquist, 2009). These variables are the coefficients in the study and methodology that is adopted in the analysis of the effectiveness and efficiency of innovation (Bartels, Ritin, & Andriano, 2016). The above is confirmed by Balzat (2006) who concurs with the pervious scholars by arguing that Nations attains competitive advantage by identifying innovation, productivity, advancement in industrialisation of economies and knowledge creation & management as key drivers needed for the development of NSI for economic, competitiveness.

Mytelka (2016) introduces the most important features of the innovation systems (IS) approach and their potential link to inclusive development and environmental issues. The study further points out the inherent weaknesses in the process that results from assumptions many people make in that all innovations are inherently good and always progressive or whether IS approach is a new wave of analytical tools which focus on soft systems methodology, value chains that have emerged as shown in the figure below:

Figure 3. 1: An innovation system model, adapted from Mytelka (2000)



Source: Mytelka (2000)

Roolaht (2012) further suggests that the implementation of innovation policies within the National System of Innovation of small countries can be determined in various ways such as the use of foresight exercises in determining science and technology priorities. The author uses the Luxembourg experience, being one of the smallest countries in the world yet the wealthiest. The process started by defining its current position in terms of research priorities against international trends about research context and later leads to the identification of possible research niche areas for the country. Secondly these identified research niches areas were formulated into broader research themes, which would outline priorities for research funding.

Jauhiainen & Hooli (2017) base their argument on the presumption that indigenous knowledge plays a significant role in developing innovation systems in developing countries. This was posited in their study where they analysed in-depth the innovation system of Namibia for the 1990s to 2016 using available research data from documents, conducted interviews with key stakeholders and drawing from past and current studies related to innovation system (IS). Their study identified challenges that hinder successful development of IS such as limited STI resources which were characterised with a mismatch between policies and practices, leading to misalignment in innovation development as actors of IS do not interact. Therefore, they recommended a doing-using-interaction (DUI) model of innovation as the most appropriate for developing countries as it is easy to facilitate the participatory innovation development processes, foster socioeconomic resilience of local communities and enhance the comparative advantage.

Oyelaran-Oyeyinka (2014) suggests that African States play a major in the process of industrialisation of states. The study explored the capacity of states in implementing innovation policy and its dynamics in driving development as market or weak state failure using a qualitative method on information and data on lessons from market or weak state failures of large industries supported by government investments taking Nigeria as a case of study.

Although emphasis on industrial failure was attributed to weak state, the study further recognised the difficulty states find themselves in of the process of acquiring technological knowhow understand and learn the dynamics of industrialisation in an environment of underdevelopment (OECD, 2012). Capacity building is identified as a critical for states to achieve industrial development hence a complex multi-level approach needs to be taken into account addressing the bottlenecks that exists as many African countries including Nigeria due to lack of skilled manpower to coordinate these different actors by taking advantage of the prospective growth across in STI African countries (Mugabe, 2000).

On the other hand, Henriques and Larédo, (2012) suggests that the development of national sciences policies is regarded as a critical innovative approach to attain national competitiveness among the Organisation for Economic Co-operation and Development (OECD) countries. This assumption was made around the 1960s when OECD countries started the process of developing National S&T policies as there were no S&T policies created before that time (OECD, 2005b). This was because the type of science interventions present then were not constituted as National S&T policies, even though public interventions supporting science were in existence. However, they not constituted as a national public policy in the same way as in other sectors such as defence, public utilities, agriculture, and industry (Lundvall, Joseph, Chaminade, & Vang, 2009).

Technological Change and Innovation supported by a network of institutions and infrastructure are considered as key drivers for national economic competitiveness (Arocena & Sutz, 2018). Accordingly to Edquist (2009) national systems of innovation are regarded as systematic innovative processes which operates as a network of institutional actors such as firms and industrial research laboratories, universities and government laboratories; government financial support (that means public money) for R&D in industry; the national system of schooling and training; and financial institutions that collaborate interdependently among themselves to initiate, import and diffuse new technologies.

The NEPAD report of 2003 indicated that there exists an explicit correlation between countries' scientific and technological readiness and that of their economic performance and the effectiveness of NSIs. This follows that, the implementation of innovation policies helps countries to close the knowledge gaps and narrow the economic divide of both countries (Mugabe, 2009). With the above in mind, the study needs to address the knowledge gaps and economic imbalances that exist between the two countries being studied and recommend solutions for implementation for Namibia to be comparably better than Botswana on a national economic competitiveness level.

3.4 Summary of Literature Review

Chapter three presented the overall theoretical framework of national systems of innovation as expounded by key scholars like Frenken, (2006), Archburgi, Howells & Michie, (1999), Lundvall *et al.,* (2009), Nelson (1993), Martin (2012), Leidesdorff (2009), Aubert (2004), Teixeira (2013), Arocena & Sutz (2018) , (Mugabe, 2009), Chinsembu *et al.*, 92012), Morone & Taylor, (2010), Looli (2016), Mytelka (2016) and (Lopez, 2014). Several models of NSI were discussed at length in relation to thematic areas identified from the research questions: characteristics of NSI, University-Industry Linkages, and STI for wealth creation, challenges countries face in implementing STI policies, Lessons learnt on improvement of STI and strategy and STI policy framework and strategy.

The Chapter also discussed the empirical literature relevant to the study, presenting empirical evidence of similar studies done on the chosen topic focusing on the most recent studies, methodologies used, findings and recommending areas for further studies. Chapter four presents the Research Methods applied in the research.

CHAPTER FOUR: RESEARCH METHODOLOGY

4.1 Introduction

This chapter presents the research methodology used in the study. The chapter is divided into seven sections. Section 4.2 introduces a research paradigm to help lead the research, section 4.3 discusses the research design applied in the study, and the population of the study is presented in section 4.4. Section4.5 provides a discussion on the sample and the sampling methods used to arrive at the selected sample of the study. Section 4.6 presents the instruments used in the study for collecting primary data. Section 4.7 presents data collection and the procedure applied to both quantitative and qualitative research. Section 4.7 presents the tools used in analysing the data of the study. Finally, Section 4.8 presents a summary of chapter 4.

4.2 Research Paradigm

Studies done by Hooli (2016) and Lopez (2014) attest to the scarcity of studies on how innovation policies help countries to attain economic competitiveness. Howerver, Jauhiainen & Hooli, (2017) in their recent published paper on how the inclusion of IK in the development of an IS in developing countries' innovation systems using the (Doing Using and Interacting) DUI mode of innovation guided the study. The application of the DUI mode of innovation in developing an STI based IS requires proper coordination to avoid a situation where the mode fails the suggested IS from attaining competitiveness.

The advantage of the DUI mode is that it is more open and even allows the participation of local inhabitants who often do not have formal education and advanced competencies in the development of a national IS (Chesbrough, 2003; Jauhiainen & Hooli, 2017).

4.3 Research Design

The research design adopted by the study was a pragmatic philosophical worldview of explanatory sequential mixed methods as follows: quantitative data was collected by means of questionnaires, analysed and results were further explained using information generated using qualitative techniques on key informants selected from the quantitative research phase (Creswell, 2014). Qualitative techniques used in the study were that of a case study comparing the two NSIs which involved asking non-structured questions to key informants purposefully sampled from respondents who participated in the quantitative phase to provide further explanations to questions not well answered or clarified (Tashakkori & Teddli, 1998). The quantitative data was gathered through structured questions sent to sampled respondents through a questionnaire that was emailed (Creswell, 2014). As Per Creswell (2014) the mixed methods design approach in research involves a combination of both qualitative and quantitative research design of generating data to address the selected research problem (Creswell, 2014).

On the same line of thinking, Kumar (2014, p25) argues that the mixed method approach is preferred over a single method as these methods look at the relation and ability to respond to a paradigm of accuracy in the answers generated from the research questions in all situations as often single methods may not give a complete or accurate solution to the problem or situation being researched. Kumar further presents the advantages of mixed methods over single a method as qualitative and quantitative research methods have the benefit of looking at a research problem from a different perspective as it allows researchers to get accurate information about the area of study as well as providing an explanation to the research problem by further engaging respondents of the study (Kumar, 2014).

Creswell (2014) further explains that these methods can be classified into three primary models starting with the Convergent parallel mixed methods which are characterised by converging or merging quantitative and qualitative data for providing a comprehensive analysis of the research problem. Under this model, data from both research designs is collected simultaneously and information generated from the data is integrated and used for interpretation of overall results. This model was found not suitable for the study because the selected study is comparative hence it has a strong quantitative orientation which requires the researcher to first do a quantitative study, analyse the findings and confirm the unclear responses with a qualitative study (Creswell, 2104).

The second model is the explanatory sequential mixed methods where the researcher commences with quantitative research, analyses the results, and further explains those results using data from qualitative research. The mixed method approach used in the study was explanatory sequential mixed method because the initial quantitative data results were explained further using qualitative data and sequential because it follows a sequence in the collection of data, analysing and interpretation of results where the researcher started by conducting quantitative research by means of a survey questionnaire followed by qualitative research using semi structured questionnaires done on key informants, purposefully sampled from the population of respondents of quantitative research of the study (Creswell & Plano Clark, 2011) and (Creswell, 2014).

The third model is the reversed explanatory sequential mixed methods, where the researcher opts to start with the qualitative research phase followed by the quantitative research phase. This is done by exploring the views of participants to the intended research problem, data from this phase is then analysed and is used to build on the research instrument to be used for the second quantitative research design. This model has challenges in identifying suitable qualitative findings to be used in a sample selection for both phases of the study (Creswell, 2014).

The Phase 1 of the study was a quantitative research approach where quantitative data was gathered using a survey questionnaire method on the sample population selected from the main research population. The results from this method were analysed and explained further using qualitative data, which was collected from key informants purposefully selected from the quantitative phase (Creswell, 2014). The third phase of the research design was qualitative data gathering technique by means of semi structured interviews done on key informants selected from phase 2 of the survey who were sampled and interviewed to further explain the responses from phase 2 (Creswell, 2014; Mabhiza, 2016).

This approach was used with an understanding that quantitative and qualitative methods employed during triangulation complemented each other in providing enriched or detailed thesis that would not be available if only one method was used in the study. Thus, triangulation has been found to be more useful in providing comprehensive data and which leads to an increased validity and reliability of results (Bekhet & Zauszniewski, 2012).

4.4 Population

The total targeted population for phase one of the study from the three categories was 839 respondents conveniently selected and 12 respondents for phase two were chosen from the respondents of phase one of the study using the 10% rule from where samples were drawn using purposive sampling methods (Creswell, 2014).

The population of this study was divided into three strata, namely: the policy layer (macro level); Operational; Agency/ Programmes level and lastly the Research-Technology Development Performers layer.

4.4.1 The policy layer (macro level)

Under this layer the following classification was further done to categorize respondents for the study. This categorization was done to classify respondents falling under the Legislative category where a target population group was drawn from members serving in the Parliamentary Standing Committee on ICT and Innovation and; the Executive category targeted government ministries with Research, Innovation, and Industrial Policies from both Namibia and Botswana.

4.4.2 Operational: Agency / Programmes level

Under the above layer the following agencies were identified as the population for the study. This layer targeted National agencies established by both countries to implement National Research Science and Technology Policies and strategies in both countries. For this study, the respondents from the two institutions namely the National Commission on Research Science and Technology (NCRST) of Namibia and the Botswana Institute for Technology Research and Innovation (BITRI) of Botswana served as the target population for the study.

4.4.3 Research, Technology Development Performers layer

This is where all listed implementing institutions were grouped. The Namibia Chamber of Commerce and Industry (NCCI), the University of Namibia (UNAM), the Namibia University of Science and Technology (NUST), The International University of Management (IUM), the Chamber of Mines, Botswana Innovation hub, Namibia Business Innovation Institute (NBII), Botswana Bureau of Standards, the University of Botswana (UB) and the Botswana University of Information Science and Technology (BUIST).

Table 4. 1: Population Size

Category	**Institutions**	**Estimated population for the study**
Policy Level	Ministries responsible for STI, OPM, Planning & Economic from both countries, Industrialisation ministries	210
Operational: Agency/ Programme Level	NCRST, BITRI, NTA, NCHE, BBS, &NSI,	123
Research Technology Development level	BIH, UB, BIUST, NUST, UNAM, NBII, MRC, SANUMARC & NCCI	406
Total		839

Source: Author's Compilation

4.5 Sample

The study used 10% rule to determine the sample size for the quantitative phase from a stratified population estimated at 839 which gave the intended sample to 84.

The researcher sent out 209 questionnaires using email. Out the 209 questionnaires 123 were received making it a 58.9 % response rate. Later, the researcher applied the 10% rule in determining the sample size for key informants for the qualitative phase of the study from the 123 respondents that participated in the survey to arrive at the approximate number of 12 interviewees for phase two. These interviewees were purposefully sampled and interviewed using semi structured questions where the researcher focused his study on the selected key informants sampled from the institutions/ministries. The three phases are presented in the following text below:

4.5.1 The policy layer (macro level)

Under this layer the following were identified: In Namibia were the respondents from The Parliament (Parliamentary standing committee on STI and ICT, The Executive (government ministries with research, innovation and Industrial policies and the National Commission on Research Science and Technology (NCRST). In Botswana, respondents under this category were selected from officials from the Ministry of Communication, Science and Technology.

4.5.2 Operational: Agency/ Programmes level

Under this layer the target sample group was drawn from the agencies mandated to administer and implement the national research and innovation agendas of Botswana and Namibia namely: The National Commission on Research Science and Technology NCRST) on the National programme on Science Research, Technology and Innovation 2013/2017, The National Council on Higher Education (NCHE) and the Namibia Qualifications Authority on the accreditation and registration of academic programmes on the National Qualification Framework, the National Training Authority (NTA) for skills development and Technical & Vocational Education Training (TVET) and from the Botswana side, respondents from the Botswana Institute for Technology Research and Innovation (BITRI) formed part of the population group under the above category.

4.5.3 Research, Technology Development Performers layer

This layer was the most critical contributor to the overall sample group because of the high number of research and educational institutions in both countries. The following were identified as key potential targeted sample groups under the Research, Technology Development Performer Layer. In Namibia, institutions such as the Namibia Chamber of Commerce and Industry (NCCI), the Namibia Chamber of Mines, Goebabeb Research and Training Centre, Desert Research Foundation of Namibia (DRFN), Namibia Nature Foundation (NNF), and the Cheetah Foundation of Namibia. Secondly, the educational institutions in Namibia like the University of Namibia through its R&D centers: the MRC, SANUMARC, schools and faculties, the Namibia University of Science and Technology (NUST)' schools, FABLAB, the Namibia Energy Institute (NEI) and the Centre for Entrepreneurship Development (CED) and the Namibia Business Innovation Institute (NBII). From the Botswana side, the targeted institutions were the Botswana Innovation Hub (BIH), Botswana Bureau of Standards (BBS), University of Botswana (UB) and Botswana University of Information Science and Technology (BUIST).

The table below presents a summary of the sample in the form of respondents interviewed during the quantitative phase.

Table 4. 2: Sample Size

Category	**Institutions**	**Position held by respondent**	**Number of respondents interviewed**
Policy Level	Ministries responsible for STI, OPM, Planning & Economic from both countries, Industrialisation ministries	Permanent Secretary/DPS	9
		Directors in governments	8
		Deputy Directors	5

Operational: Agency/ Programme Level	NCRST, BITRI, NTA, NCHE, BBS, &NSI,	Chairpersons of Boards/ council	1
		Vice Chancellor/Rector	1
		Director of Research/ Innovation Centre (includes CEO/MD)	18
		Research/ Innovation coordinator	2
Research Technology Development level	BIH, UB, BIUST, NUST, UNAM, NBII, MRC, SANUMARC & NCCI	Senior Researcher/ innovator	24
		Researcher/ Innovator	9
		Technician	5
		Engineers	3
		Deans & HODs	10
		Other (private & Business sector)	23
		Technology Transfer Officer	2
		Medical Doctor/ Officer	3
Total			123

Source: Author's own compilation

4.6 Research Instruments

The study used survey questionnaires in phase one which used the quantitative research method to collect its primary data from the selected key informants from the ministries, agencies and higher education institutions; while secondary data was obtained from R&D and Innovation manuals like OECD, AOSTI, Frascati, Oslo, UNESCO statistics, NSA statistics, NEPAD indicators, UNCTAD databases, National STI policies and regulations, Ministerial and Institutional strategic plans, Internet based sources such as websites and library collections of journals and periodicals.

Secondly, the study also used semi structured interviews to gather qualitative data from the key informants who would be sampled using a purposeful sampling method to further explain responses from phase 1 of the study (Creswell, 2014; Mabhiza, 2016).

4.7 Data Collection Procedure

Data was collected by means of using convenience sampling techniques where questionnaires were distributed to selected key informants using the purposive sampling method where Heads of Departments in government ministries, CEOs of key research institutes, laboratories, and institutions of higher learning in Namibia and Botswana. Secondary data was obtained from articles and reports such as OECD reports, UNESCO science reports, Innovation surveys, Frascati and Oslo manuals and other documents on innovation. (OECD, 2005a, 2005b & 2007). The interviews focused on the following issues or aspects of the review: The first was to establish an understanding of the interviewees on NSI in relation to the thematic areas generated from the research questions and how effective were the two national systems of innovation, looking at the strengths and weaknesses of the two systems and what specific measures were to be instituted for them to attain national economic competitiveness.

4.7.1 Quantitative data Collection Procedures: Phase one

The researcher sent 209 questionnaires (105 to Nmaibian respondents and 104 to Botswana respondents) for the quantitative part in phase one of the study. These respondents were grouped into three strata of the selected categories for classification of NSI model for the study as follows: 1) STI strategic guidance and direction at policy level (permanent secretaries / Director Generals; Directors in governments) were targeted; 2) Operational Agency / Programme targeted CEOs, Executive Directors, Senior researchers of national agencies established by both countries to implement National Research, Science, Technology and Innovation Policies and strategies from both countries; 3) The last category was the Research Technology Development (RTD) category, targeting implementers / innovators / scientists / entrepreneurs and researchers and scholars. Secondary data was used to supplement the responses from phase one of the study as obtained from articles from journals, library material such as text books and online periodicals, articles, and the internet.

4.7.2 Qualitative data collection procedures: Phase Two

Qualitative data collection was built directly onto the quantitative results that were extreme outliers which required more clarification. Therefore, during phase two, 12 key informants were purposefully sampled from the same sample of 123 respondents who participated in the quantitative phase one. These key informants were drawn from both countries on a 50/50 representation to follow up on those of the quantitative results and to explore the results in more depth to seek clarification for further understanding of the research phenomena using semi-structured interviews (Creswell, 2014; Mabhiza, 2016).

According Mabhiza (2016) the face to face interviews on key informants purposefully sampled using semi-structured questionnaires was considered to be more appropriate than other qualitative data collection methods, such as, observations or focus group discussions, because they allowed the researcher to have control over the line of questioning and enabled the researcher to supplement some of the answers given by the 123 respondents in phase one of the study.

4.7 Validity and Reliability

Good research requires measurement tools that are both reliable and valid for the subject under study. Validity and reliability are psychometric properties that describe the degree that research instruments reliably and validly capture the data required for the study. Valid instruments accurately and correctly measure the study variable. Reliable instruments produce consistent, reputable data for the same study circumstances and between users of the instrument (Creswell, 2014).

Validity refers to the extent to which these inferences are sound. Validity, therefore, is not a characteristic of the research instrument itself, it rather refers to the ways a researcher interprets and uses measurement results whilst reliability on the other hand refers to the consistency of the measurement results and the extent to which they are accurate, error free, and stable. To ensure validity and reliability of the instruments, a triangulation method was more appropriate as the method applies techniques that combine multiple observers, theories, methods, and empirical materials of several research methodologies in the study to analyse the same phenomenon. This is beneficial to researchers as it helps to overcome the weaknesses or intrinsic biases and the problems that could be experienced from a single method, single-observer, and single-theory studies and methodology (Creswell, 2014).

Creswell (2014) acknowledges that the type of research approach chosen by a researcher in any research, regardless of whether it is quantitative, qualitative, or mixed method is dependent on the trustworthiness, authenticity and credibility of the overall research results, quantitative scores, data sources, and research participant. Therefore, validity helps the researchers to draw meaningful and useful inferences from scores on instruments used in case of quantitative methods and further assist with the determination of the accuracy of the findings from the qualitative phase by applying techniques like triangulation of data sources (Creswell, 2014).

The study used the Kieser –Meyer Olikin (KMO) and Bartlette Test to test for validility and reliability of results generated from the sample.

4.9 Data analysis

The data collected from the survey using questionnaires in phase 1 of the study was coded and computerized using the statistical software package, SPSS. Furthermore, from SPSS the research used descriptive statistics and an exploratory factor analysis to organize and analyses statistical data by doing cross tabulations which led to the generation of frequency distributions from which inferences would be drawn on the identified categories and variables to be measured in the study (Creswell, 2014; Mabhiza, 2106).

The commonality and Kaiser-Meyer-Olikin (KMO) and Bartlett's tests was conducted on the data to test sampling adequacy of the sample population.

Table 4. 3: KMO and Bartlett's Test

KMO and Bartlett's Test[s]		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.500
Bartlett's Test of Sphericity	Approx. Chi-Square	7.085
	df	1
	Sig.	.008

Source: Primary Data

Results from Table 4.3 above indicates that the sample collected was adequate to proceed with data analysis judging from the Chi-Square value of 7.085 and significance value of .008, which is not significant, hence credible and valid results would be produced from the data analysis.

4.10 Summary of Chapter Four

Chapter four discussed the research methodology used in the study, which was Mixed Methods Research (MMR). The researcher explained the paradigms and pragmatics view associated with the research approach. The chapter was divided into Seven Sections, with Section 4.2 discussing the research design applied in the study, followed by the population of the study which was presented in section 4.3. Section 4.4 provided a discussion on the sample population and the sampling methods used to arrive at the selected sample of the study. Section 4.5 presented the instruments used in the study for collecting primary data. Section 4.6 presented data collection and the procedures applied to both quantitative and qualitative research. Section 4.7 presented the research instruments used in analysing the data for the study. Finally, the remaining sections of the chapter discussed in detail the data analysis, validity & reliability and ethical considerations employed in the study. A detailed interpretation of research findings and discussion of results is presented under chapter five of the study.

CHAPTER FIVE: EMPIRICAL FINDINGS AND DISCUSSION OF THE RESULTS

5.1 Introduction

Empirical findings and discussions of the results of the study are presented in the following sections below: Section 5.2 discusses the empirical findings applied in the study, Section 5.3 presents the discussions of results of the study. Finally, Section 5.4 presents a summary of chapter 5. Furthermore, the chapter presents the findings on a comparative analysis drawn from the results of respondents on the research themes against the empirical framework from literature review in chapter 3 on how Namibia and Botswana National Systems of Innovation assist these countries to attain national economic competitiveness.

5.2 Empirical Findings

The chapter starts with a discussion on the response rate and demographic profiles which comprise of the following: Age, Gender, Educational Qualification, Job category, Position held in the organisation and Years of experience. Thereafter the researcher discusses the findings from the questionnaire responses, from the three categories (policy level, operational/ agency level and the Research, Technology Development and Programme level) as defined in the population and sample and ending with the discussion and interpretation of the findings.

5.2.1 Response Rate

209 questionnaires for the quantitative research in phase one of the study were emailed to the sample as defined in Section 4.4 of key respondents from Namibia, 105 questionnaires were sent and only 67 responses were received and Botswana 104 questionnaires were sent and 56

responses were received binging the total questionnaires received to 123, making a response rate of 58 % which was representative enough to allow the continuation with data analysis.

Whilst in the qualitative research phase two, a total of 12 (Namibia (6) and Botswana) (6) respondents out of the 20 purposefully sampled respondents from phase one participated in the interviews, making the response rate 50% which is an average acceptable representative sample for the study.

5.3 Demographic Analysis

Zikmund and Babin (2010) urges that demographic data is important in research because it provides guidance and reliability of the results. For example, a highly experienced respondent holding a senior position at policy level will more likely provide informed responses on the characteristics of NSI, STI Policy and Strategy and contribution factors of STI to create wealth than an unexperienced respondent operation at the Research, Technology and Development Level (researchers in the labs).

Furthermore, this section covers the descriptive analysis of demographic profiles drawn from the quantitative research questionnaire under phase one. This includes gender, years of experience, level of education, level or position held in the organisation and job category in the three mentioned groupings that were used in the study to categorize the various layers forming the NSI model as described in the section.

5.3.1 Gender

This section presents results of the gender of respondents who participated in phase one of the study as shown on the table below:

Table 5. 1: Demographic information Gender

Demographic Information: Gender					
		Frequency	Percent	Valid Percent	Cumulative Percent
Demographic information	Male	72	58.5	58.5	58.5
	Female	51	41.5	41.5	100.0
	Total	123	100.0	100.0	

Source: Primary Data

The Table 5.1 above indicates 72 males responded giving a 58.5 % of the total respondents and 51 females participated in the survey giving 41.5%. These results do not pose a threat to the study as they are a true reflection of what is on the ground in both countries when it comes to STI e.g. most permanent secretaries / deputy permanent secretaries and CEOs of STI agencies are male.

Table 5.2 shows that the age categories segregated by gender were the majority of participants in the study falls in the age group between 40 and 44 years representing 30.1 % of the total respondents (N=123). This was followed by the 30 to 34 years age group representing 16.3 % whilst those that fall between 35 and 39 years representing 14.6 %. Furthermore, the age group between 45 and 49 years was 12 respondents representing 9.8% and 8.9% was from those respondents falling in age group 55 to 59 and above. The lowest representation was from age category of 25 to 30 years accounting for 4.9%. These results paint a good picture about the future sustainability and continuity in implementing policies and strategies that will help the two National Systems of Innovation to thrive for economic competitiveness from an age perspective because of the large representation of youth s from the (45 years and below) in the study.

Table 5. 2: Age Category

Gender & Age Category Cross – Tabulation (Male)										
										Tot
			25-29 yrs	30-34 yrs	35-39 yrs	40-44 yrs	45-49 yrs	50-54 yr.	55-59 yrs	
1.1 Gender	Male	Count	3	11	10	19	9	12	8	72
		% within Gender	4.2 %	15.3%	13.9%	26.4%	12.5 %	16.7%	11.1%	100.0%
		% within 1.2 Age Category	50.0%	55.0%	52.6%	51.4%	75.0 %	66.7%	72.7%	58.5%
		% of Total	2.4 %	8.9%	8.1 %	15.4%	7.3 %	9.8%	6.5 %	58.5%

Source: Primary Data

Table 5. 3: Age Category and Gender (cont'd)

Gender & Age Category Cross – Tabulation (Female)										
Gender	Female	Count	3	9	9	18	3	6	3	51
		within 1.1 Gender	5.9 %	17.6%	17. 6%	35. 3%	5.9 %	11.8%	5.9 %	100.0 %
		% within 1.2Age Catego ry	50. 0%	45.0%	47. 4%	48. 6%	25.0 %	33.3%	27. 3%	41.5%
		% of Total	2.4 %	7.3%	7.3 %	14. 6%	2.4 %	4.9%	2.4 %	41.5%
Total		Count	6	20	19	37	12	18	11	123
		% within 1.1 Gender	4.9 %	16.3%	15. 4%	30. 1%	9.8 %	14.6%	8.9 %	100.0 %
		% within 1.2Age Catego ry	100 .0%	100.0 %	100 .0%	100 .0%	100. 0%	100.0 %	100 .0%	100.0 %
		% of Total	4.9 %	16.3%	15. 4%	30. 1%	9.8 %	14.6%	8.9 %	100.0 %

Source: Primary Data

Table 5. 4: Academic Qualifications

Academic Qualifications					
		Frequency	Percent	Valid Percent	Cumulative Percent
Academic Qualifications	Degree Holder	22	17.9	17.9	17.9
	Masters Holders	57	46.3	46.3	64.2
	PhD or Equivalent	44	35.8	35.8	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Table 5.4 shows that the participants are highly educated with only 17.9% having a minimum degree qualification, 46.3 % having Masters Degrees, and 11.8% being PhD holders and above. This implies that the Namibia and Botswana National Systems of Innovation have qualified people who could drive the implementation of STI & Industrial policies, translating research and innovation outputs into products and services that are economically viable for advancing national economic competitiveness.

Table 5. 5: Job Category of Respondents

Job Category of respondents					
		Frequency	Percent	Valid Percent	Cumulative Percent
Job Category	Policy Makers	18	14.6	14.6	14.6
	Operational Innovation Agencies	35	28.5	28.5	43.1
	Research, Tech. Development (implementers)	70	56.9	56.9	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Table 5.5 above indicates that the majority of respondents who participated in the survey was at policy implementer/ performers level (research, technology and development) constituting 59.9 %, followed by those heading operational agencies tasked with the responsibility of coordinating the STI and industrial polices and strategies which made up 28.5% of the total sample. The policy makers / high-ranking government officials from (government ministries and parliament standing committee for research, innovation and Technology) had the least score of 14.6% as a result of a lower number of respondents compared to the other levels as shown in Table 5.5, which presents the results on “Position held in the Organisation”.

Table 5. 6: Position held in the Organisation

Position Held in the Organisation					
Category	Position held	Frequency	Percent	Valid Percent	Cumulative Percent
Policy Level/ Operational: Agency /Programme Level, Research Technology Development Level (including Private Sector & Business and Higher Education Institutions)	Chairperson of Board/ Council	1	.8	.8	.8
	Vice Chancellor / Rector	1	.8	.8	1.6
	Permanent Secretary / DPS	9	7.3	7.3	8.9
	Director in Government O/A/M	8	6.5	6.5	15.4
	Director of Research/ Innovation Centre	18	14.6	14.6	30.1
	Deputy Director	5	4.1	4.1	34.1
	Senior Researcher / Innovator	24	19.5	19.5	53.7
	Researcher / Innovator	9	7.3	7.3	61.0
	Engineer	3	2.4	2.4	63.4
	Technician	5	4.1	4.1	67.5
	Technology Transfer Officer / Specialist	2	1.6	1.6	69.1

Source: Primary Data

Table 5. 7: Position held in the Organisation (cont'd)

Position Held in the Organisation					
Category	Position Held	Frequency	Percentage	Valid Percent	Cumulative Percent
Policy Level/ Operational: Agency /Programme Level, Research Technology Development Level (including Private Sector & Business and Higher Education Institutions)	Medical Doctor/ Officer	3	2.4	2.4	71.5
	HODs	9	7.3	7.3	78.9
	Deans	1	.8	.8	79.7
	Research Coordinator/ Science officer/ Manager	2	1.6	1.6	81.3
	Other (private, business sector)	23	18.7	18.7	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Table 5.7 above illustrates the frequency of the position held in the organisation for the respondents sampled for the interviews. The highest number of respondents came from the position of senior researcher/innovators who constituted 19.5% followed by those that fall under the category of positions under others where the private and business sector fall, with a score of 18.7%. The study further found that eight Directors in government ministries and nine Permanent / Deputy Permanent Secretaries were interviewed constituting 6.5% and 7.3% respectively. Directors of Research Councils / institutes had 18 respondents which amounted to 14.6%.

5.7 Work Experience

Table 5. 8 below illustrates the number of years worked for the respondents that participated in the survey. Most of the respondents had worked in the National System of Innovation for more than six years. This amounted to 75.6% and was followed by those who had worked between three to four years, contributing 15,4% whilst those that had worked five to six years represented 4.1% and 3, 3% for respondents that had one to two years working experience and those less than one year working experience was 1.6% as indicated in the table below. The results indicated that most of the respondents in the survey had work experience of more than six years resulting in a sound understanding of National System of Innovation. One could then conclude that the responses were credible and reliable.

Table 5. 8: Work Experience

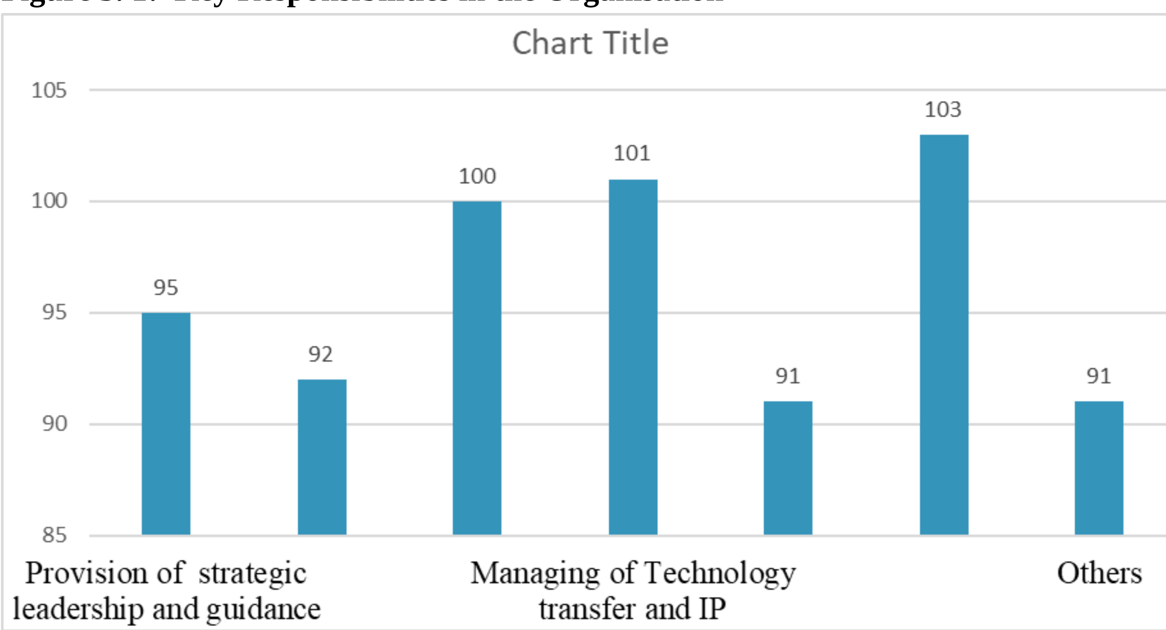
Work Experience					
		Frequency	Percent	Valid Percent	Cumulative Percent
Work Experience	Less than 1 year	2	1.6	1.6	1.6
	1 to 2 years	4	3.3	3.3	4.9
	3 to 4 years	19	15.4	15.4	20.3
	5 to 6 years	5	4.1	4.1	24.4
	Above 6 years	93	75.6	75.6	100.0
	Total	123	100.0	100.0	

*Source:*Primary Data

5.8 Key Responsibilities of respondents in the Organisation

This section probed the respondents on what they thought their key responsibilities were in the organisations they were employed in relation to national system of innovation for economic competitiveness – this was to answer Question 4.2 What are your Key responsibilities in the organisation? The respondents were given an opportunity to choose from the following statements; (1) providing strategic leadership and guidance; (2) Policy advice and monitoring the implementation of STI policy; (3) Research & Innovation Funding; (4) Management of Technology Transfer and IP; (5) Development and management of incubation/acceleration & start-up centers and (6) Coordinating research at universities/ governments/ institutes and councils.

Figure 5. 1: Key Responsibilities in the Organisation



Source: Primary Data

Figure 5.1 above indicates that 95 respondents agreed and strongly agreed that their role in the organisation is that providing strategic leadership and guidance in their respective organisations. The highest score was that of research coordination, where 103 respondents agreed and strongly agreed that indeed their role was that of research coordination at either universities / research institutes or council and in government departments or ministries. This was followed by those that fell in the categories of Research and Innovation and Management of Technology Transfer & IP with scores of 100 and 101 respectively. It was observed from above graph that the scores were very close to each other, with the reason being that research coordinators are most likely to be involved in funding aspects as well as management of the technology transfer and IP generated from the research being coordinated.

Policy advice & monitoring the implementation of STI polices and the development and management of incubation/acceleration & startups including other functions associated with development and maintenance of effective National System of Innovation with scores of 92 and 91 are very critical in guiding nations attain national economic competitiveness.

5.9 Characteristics of an effective National System of Innovation

This section responds to research questions 5.1 and 5.2.

Research Question 5.1: What are the key characteristics of an effective National System of Innovation?

5.9.1 Respondents' level of satisfaction on the characteristics of an effective National System of Innovation.

5.9.1 Evidence based STI policy

Taking a closer look at the modality of developing STI policies in Namibia and Botswana, the involvement of scientific advice in providing evidence came after the governments have already decided to develop such policies. They only involve scientific experts and other stakeholders at the drawing up of draft policy and this leads to the quality of the policy being compromised. A case in point was the approach undertaken by the National Commission on Research Science and Technology policy of during the review process of the National Research, Science and Technology (NRST) Policy of 1999, where scientific experts and key stakeholders were only involved at the validation stage of the revised Science, Technology and Innovation Policy (NCRST, 2016). Botswana on other hand involved expertise from the Council for Scientific & Industrial Research (CSIR) and other key stakeholder throughout the entire period during its review of the Science and Technology Policy 1998 (CSIR, 2005).

The study observed that coordination and governance of STI policy review was a challenge, especially for Namibia with the NCRST spearheading the review of NRST policy in developing a new STI policy. At the same time, the Ministry of Higher Education, Training and Innovation had requested UNESCO to assist Namibia with the review of its TVET, Higher Education and RST policies (UNESCO, 2016). The table 5.8 below shows how the respondents reacted to the above statement.

Table 5. 9: Evidence based STI Policies

Evidence Based STI Policies					
		Frequency	Percent	Valid Percent	Cumulative Percent
Evidence based STI Policies	Disagree	3	2.4	2.4	2.4
	Neutral	9	7.3	7.3	9.8
	Agree	25	20.3	20.3	30.1
	Strongly Agree	86	69.9	69.9	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Results in Table 5.9 above indicates 69.9% of the respondents strongly agree that evidence based STI policies are a critical tool for an effective National System of Innovation that triggers national economic competitiveness. The study also found that 20% of the respondents agreed with the above statement, whilst 7.3% of the respondents were undecided and 2.4% disagreed. Since those that agreed and strongly agreed were the majority then it is understood that indeed the existence of evidence based STI policies with good implementation plans leads to an effective National System of Innovation that will be economically competitive.

These results were in agreement with the OECD (2015) discourses on policy for science, where scientific experts were involved, providing advice on STI policy development, based on evidence of a societal need at hand and the science of policy discourse where scientific experts advise governments on the need for regulatory issues to be in place for a smooth implementation of evidence based STI policies. However, the complexity in nature of developing evidence based STI policies pushes decision makers to consider other factors in addressing the interests of a variety of stakeholders like law makers, industry, NGOs, regulators, and the public at large. This model, where the advice initiated by scientific experts under policy for science gets incorporated in the development of STI policies is a bottom up approach to the evidence based STI policy process.

The ANOVA test proved that $p>.000$ is statistically not significant (see Table 5.9.1) the study found that the extent to which evidence-based STI policies influence NSI is dependent on the availability of an education system that responds to industry demands. Furthermore, it needs to have the capabilities of producing a critical mass of skilled manpower in STI that must be supported by a well-resourced research and innovation infrastructure as well as a well-defined university-industry linkage.

Table 5.9.1: Anova Test

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	38.180	6	6.363	26.517	.000[b]
	Residual	27.837	116	.240		
	Total	66.016	122			
2	Regression	39.271	7	5.610	24.122	.000[c]
	Residual	26.745	115	.233		
	Total	66.016	122			
3	Regression	40.332	9	4.481	19.716	.000[d]
	Residual	25.684	113	.227		
	Total	66.016	122			
4	Regression	41.387	16	2.587	11.133	.000[e]
	Residual	24.629	106	.232		
	Total	66.016	122			

Source: Primary Data

Data for qualitative phase was collected from the key informants purposefully sampled from phase one of the study and analysed by means of thematic analysis on the developed research themes form research questions whose results were not clarified during phase one (quantitative phase) to establish a better explanation and understanding of the similarities and differences that may exist in the two National Systems of Innovation of between Namibia and Botswana.

5.9.2 Existence of funding frameworks for R&D

Although, funding has been recognised as one of the fundamental resources for strengthening the national innovative capability and subsequently increasing the national economic competitiveness; Firstly, there is a need to complement it with other factors like the active participation of the private sector in the NSI through a close working relationship with government in the development of SMEs and the informal sector into the manufacturing sector. Secondly, funding should be channeled to address demand driven research on societal, economic challenges as agreed in the countries' national research agendas (Ministry of Infrastructure, Science and Technology, 2011). Thirdly, development of a critical mass of skilled human capital in STI is needed to utilise the funds on providing solutions to challenges / research problems from the identified national priorities (NCRST, 2014).

On the aspects, the two countries have taken a good initiative in their STI policies by making provision for the establishment of National funding frameworks i.e. Namibia's Research, Science and Technology Act, 2004 (Act 23 of 2004). Section 24 of the act calls for the establishment of a National Research, Science and Technology Fund to provide for funding of Research, science technology and innovation (Government Gazette, 2004). The Botswana National Research, Science Technology, and Innovation policy of 2011 talks of the establishment of the Botswana National Research Fund to complement the existing Innovation

Fund (Ministry of Infrastructure, Science and Technology, 2011). The study observed a challenge in the operationalisation of the proposed institutions above that would ensure realisation of national developmental priorities. E.g. Namibia's envisaged NRSTF is still to be created under the NCRST (NCRST, 2014).

Table 5. 10: Existence of funding frameworks for R&D

Existence of funding framework for R&D					
		Frequency	Percent	Valid Percent	Cumulative Percent
Existence of funding frameworks for R&D	Disagree	2	1.6	1.6	1.6
	Neutral	17	13.8	13.8	15.4
	Agree	17	13.8	13.8	29.3
	Strongly Agree	87	70.7	70.7	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Table 5.10 above shows the results on how the respondents ranked the existence of funding frameworks for R&D as a pillar that support the development of an effective National System of Innovation. Results show that 70.7% of the respondents strongly agree that having a funding framework for R&D will produce an effective National System of Innovation. 17 out 123 respondents also agreed with the above statement. Therefore, lack of a funding framework within an NSI would be a challenge in attaining an effective NSI.

5.9.3 Well-defined University - Industry Linkages

Literature by scholars like Rast, Khabiri & Senin, (2012) and Gualt (2010) suggests that universities enter into partnerships with industry to look for new ways to remain relevant actors in the NSI. Hence having well-defined university industry linkage strategies in the National STI policies that are cascaded down to individual university research and innovation policies is very important to both countries' quest of improving their competitiveness status.

Table 5. 11: Well defined University Industry Linkages

Well defined University-Industry Linkages					
		Frequency	Percent	Valid Percent	Cumulative Percent
Well defined University-industry linkages	Disagree	1	.8	.8	.8
	Neutral	6	4.9	4.9	5.7
	Agree	32	26.0	26.0	31.7
	Strongly Agree	84	68.3	68.3	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Results in Table 5.11 above indicates that from the opinions of the respondents interviewed, having a well-defined university-industry linkage within an innovation system, makes it effective. This is confirmed by the high percentage of those that strongly agreed with the statement (68.3%) and merely agreed, (26%) that "well-defined university industry linkage" is one of the initiatives needed to develop an effective National System of Innovation that is economically competitive.

5.9.4 Education System that respond to industry demands

An educational system that respond favourably to the demands of industry serves as a positive attribute leading to an effecive national system of innovation. The study probed the respondents's veiw on whether an eduaction system that responds to the demand of industry leads to an effective National System of Innovation. The table 5.12 below shows the respondents' reaction the above statement.

Table 5. 12: Education System that responds to industry demands

Educational system that respond to industry demand					
		Frequency	Percent	Valid Percent	Cumulative Percent
Educational system that respond to industry demand	Strongly Disagree	2	1.6	1.6	1.6
	Disagree	1	.8	.8	2.4
	Neutral	11	8.9	8.9	11.4
	Agree	28	22.8	22.8	34.1
	Strongly Agree	81	65.9	65.9	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Table 5.12 above presents the results of the respondents on whether having an education system that responds to the demands of industry will lead to an effective National System of Innovation. The respondents that participated in the interviews unanimously agreed that a good education system developed on the demand of industry, would likely be able to produce the required knowledge needed by industry to innovate and produce more goods and services. Once traded, this would result in an increase in the country's GDP and improvement in trade balance. The study further found that 81 out of 123 respondents strongly agreed (65.9% with the proposed statement "Education System that responds to industry demand" as a good initiative that Namibia and Botswana must adopt to attain economic competitiveness.

These results support the findings of Namibia's Technical Vocational Education and Training (TVET), Higher Education and Innovation policy review conducted by the Ministry of Higher Education, Training and Innovation with technical assistance from UNESCO in 2016. The review also identified the existence of weaknesses of not having strong linkages of articulation in Namibia's education system, from vocational education and training with universities (UNESCO, 2016). This results in VET and higher education reviews that graduates are facing a challenge of fitting well in formal employment or venturing into entrepreneurship due to lack of entrepreneurship skills and industry skills demand during their training.

Botswana on the other hand have successfully achieved universal access to education from primary, secondary, vocational training and tertiary levels. It has done so by putting in place supportive institutions like the Education Fund. This has translated into increased numbers of graduates as well as available opportunities for industry participation in skills through institutions like the Botswana Innovation Hub and the Botswana Education Hub (UNESCO, 2013).

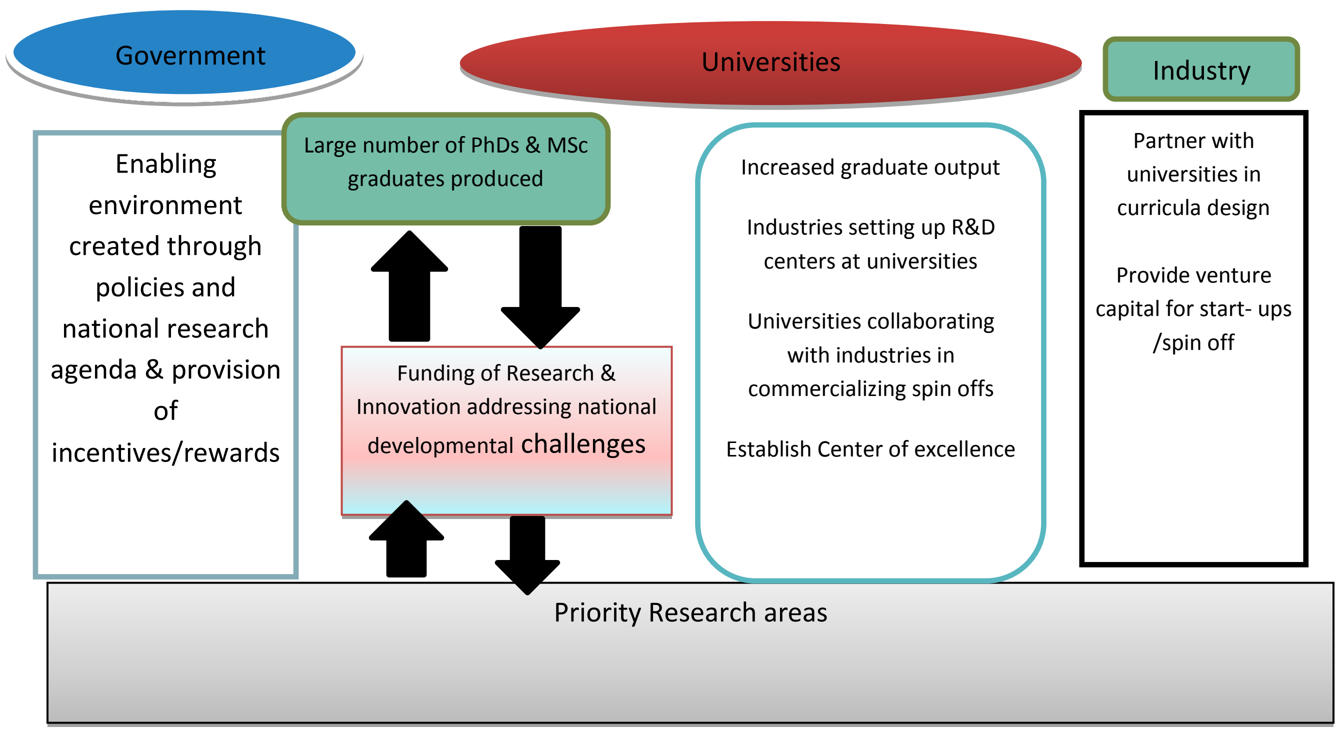
Namibia on the other hand, has not yet achieved universal access to education at all levels, making it difficult for the education system to respond to the demands of industry, even though institutions like the Namibia Training Authority on skills development and the National Council on Higher Education (NCHE) on quality education are relevant to the demands of industry (UNESCO, 2016).

The above statements agree with Burns (2001) that the key role of education with emphasis on educating scientists should lead to an increase in productivity and economic growth for Namibia. Therefore, government through its ministries and public agencies must work in harmony with the private sector in integrating STI and entrepreneurship in the education system (Ministry of Higher Education Vocational Training Science & Technology, 1999).

This would require change agents to champion the reforms in the education system to allow the development of instruments i.e. a curriculum addressing the demands of industry; incentive schemes to support students and researchers and on the job training to students through internships. Secondly, the development of appropriate infrastructure (laboratories, scientific equipment) to support STI would lead to the attraction, retention and motivation of learners/students to STEM fields (Fullan, 1993).

The study further proposes the following framework to serve as a model of linking educational institutions' output to with industry demand:

Figure 5. 2: Framework for Education System responding to Industry Demand



Source: Author's own compilation

Figure 5.2 above proposes a model for a framework for an education system that responds to industry demand, built on the tripartite partnership between government / universities and industry.

5.9.5 Number of patents registered

The number of patents registered has in the past been regarded as a strong measure of the effectiveness of a country's NSI and economic competitiveness. Of late, however, many developed countries have moved away from the reliance on measuring their competitiveness based on the number of registered patents only without introducing initiatives on what to do with those registered patents. This is due to the huge cost associated with the maintenance of patents.

Table 5. 13: Number of patents registered

Number of Patents registered					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Disagree	1	.8	.8	.8
	Disagree	3	2.4	2.4	3.3
	Neutral	13	10.6	10.6	13.8
	Agree	25	20.3	20.3	34.1
	Strongly Agree	81	65.9	65.9	100.0
	Total	123	100.0	100.0	

Source: Primary Data

However, many developing countries including Namibia and Botswana are still using patents registered as a measure of strength for improving research output at universities and research institutions as patents are generated from research and innovation activities undertaken by these institutions. The latter is confirmed by responses from the respondents in the above table which indicated that the majority, with a combined percentage of 86.2% agrees that the number of patents registered have a high correlation with the volume of research output produced at universities and research institutes.

If universities and research institutes are to remain key contributors to the generation of patents through R&D and innovation, a paradigm shift in their operations needs to be effected for them to start thinking in the line of technology licensing and commercialising of research output through the establishment of trading companies to transform research prototypes & spinoff into commercial viable products and services (Gachie & Govender, 2017). In this regard, the University of Namibia has come up with a good initiative by creating a trading company that will be responsible for entering into business ventures with industries to develop carry R&D prototypes into product and services that are commercially viable (University of Namibia, 2016).

5.9.6 Triple helix model for innovation

The interaction between government/ academic and industry during the development of a National System of Innovation is important to ensure that the system being built will respond to the needs of all. Hence, a triple helix model approach for NSI development could be a good initiative that lead to the contributing to an effective national system of innovation (Etzkowitz, 2008). The study posed the question to the respondents to determine their understanding and whether they agree of statement with the statement.

The Table 5.14 below shows the responses from the respondents on the matter.

Table 5. 14: Triple Helix Model for Innovation

Triple Helix model for innovation					
		Frequency	Percent	Valid Percent	Cumulative Percent
Triple Helix model for innovation	Disagree	4	3.3	3.3	3.3
	Neutral	9	7.3	7.3	10.6
	Agree	31	25.2	25.2	35.8
	Strongly Agree	79	64.2	64.2	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Table 5.14 above shows that the majority of the respondents strongly agree (64.2%) that in developing an effective NSI, adopting a triple helix model of innovation allows the participation of all players from government, academia, and industry.

These results agree with what scholars like Freeman (1988); Nelson (1988) and Lundvall (1988) who posited, that the triple helix model was used as an alternative approach in defining the theory of the innovation system. This was later refined to a national system of innovation which was constituted by a set of innovation actors whose activities were inter-linked.

A critical analysis of Botswana's National Research, Science, Technology and Innovation policy and the Vision 2016 reveals that a triple helix model approach is addressed in its first three objectives as follows: to attain a status of an educated, informed nation where its citizens are empowered to become innovators through active participation of all innovation actors (firms, universities, governments and the private sector) in economic growth. The second objective talks of the relevance of a prosperous, productive and innovative nation that economically sustains its growth and diversification to produce entrepreneurs who would create employment (Ministry of Infrastructure, Science and Technology, 2011).

Namibia on the other hand also agrees with the model as the NRST Policy of 1999 has clear guiding principles supporting the development of an innovation system through interaction between the public and private sector and critical clusters of scientific institutions in designing national research goals. Whereas government's role is that of creating an enabling environment and providing investments to STI multidisciplinary programmes of national interest (Ministry of Higher Education Vocational Training Science & Technology, 1999, .

5.9.7 Critical mass of skilled workforce in STI

The provision of the critical mass of skilled STI personnel has been a key priority for Namibia since the early years of independence. Although, the government has been investing over 24% of its national budget on education and training, still Namibia's performance on the regional SACMEQ results on reading and numeracy skills, has been the last in the SADC region for past 12 years. The education system is also responding to industry demand and national economic needs for skills in sciences, technology, engineering and mathematics (STEM).

Funding of human resource development in skilled manpower in science and technology has been a challenge. For many years, the bulk of the education budget was channeled to primary and secondary levels, leaving less money for the training of required STI personnel in the form of medical doctors, engineers, biologists, agricultural scientists and veterinary doctors who are critical to the development of a prosperous and industrialised competitive nation that enjoys harmony and political stability (Government of the Republic of Namibia, 2004).

Table 5. 15: Critical Mass of skilled workforce in STI

Critical mass of skilled manpower in STI					
		Frequency	Percent	Valid Percent	Cumulative Percent
Critical mass of skilled workforce in STI	Strongly Disagree	1	.8	.8	.8
	Disagree	3	2.4	2.4	3.3
	Neutral	8	6.5	6.5	9.8
	Agree	27	22.0	22.0	31.7
	Strongly Agree	84	68.3	68.3	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Table 5.15 above shows the respondents' reaction to the statement that "Critical mass of skilled manpower in STI" leads to an effective national system of innovation. This is confirmed by the high percentage of those that strongly agreed (68.3%) and merely agreed (22%) to the statement that "critical mass of skilled manpower in STI" is one of the initiatives needed to develop an effective National System of Innovation that is economically competitive.

To overcome the challenge, the governments of Namibia and Botswana that committed themselves to invest over 23% of the national budgets allocation to the education, science technology and innovation sectors (Government of the Republic od Namibia, 2012; Ministry of Finance & Develoment Planning, 2007). Secondly, the governments have vowed to adhere to the provisions of the SADC Protocol on Science, Technology and Innovation compiling members states to spend 1% of their GDP on R&D (SADC, 2008) and the African Union declaration to set aside 1% of GDP to be spend on R&D by members states by 2020 (African Union, 2014).

5.9.8 High contribution from SMEs

Namibia's industrial and SME policies - the growth at home strategy has explicitly focused on value addition, which could be beneficial to SMEs. The Ministry of Industrialisation, Trade and SME Development in Namibia also administers the Infancy Industry Protection Policy which provides an opportunity to SMEs intending to advance to the manufacturing stage. The Development Bank of Namibia through its SME portfolio provides financial assistance in the form of loans/grants which are non-collateral based, to SMEs and informal traders. In addition, local commercial banks' operations in Namibia like the First National Bank of Namibia (FNB), Bank Windhoek, Standard Bank Namibia, the Agricultural Bank of Namibia, and Nedbank all have facilities to financially support SMEs.

The Botswana government also values the contribution of SMEs and informal markets to economic growth and employment creation, hence, the reason for the provision of credit schemes targeted at supporting SMEs at various financial and developmental institutions like the Center for Entrepreneurial Development Agency (CEDA); the National Development Bank of Botswana (NDB); the Botswana Development Corporation (BDC) and other commercial banks operating in Botswana.

However, with all these opportunities available to SMEs in Namibia, access to these funds remains a challenge as the majority the SMEs and informal traders lack the knowledge of developing bankable business plans. Hence, the ministry of Industrialisation, trade and SME development in partnership with the Namibia Chamber of Commerce and Industry has introduced a mentorship programme that is aimed at equipping SMEs with skills of developing business plans (Ministry of Industrialisation, Trade & SME Development, 2016).

Table 5. 16: High Contribution from SMEs

High contribution from SMEs					
		Frequency	Percent	Valid Percent	Cumulative Percent
High contribution from SME	Disagree	4	3.3	3.3	3.3
	Neutral	10	8.1	8.1	11.4
	Agree	29	23.6	23.6	35.0
	Strongly Agree	80	65.0	65.0	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Results on Table 5.16 above show how the respondents reacted to the statement "High contribution from small and medium enterprise" towards an effective national system of innovation. Most of the respondents strongly agreed with the above statement, hence the score of 65% followed by those that merely agreed, which constitutes 23.6 % of total, 8.1% were undecided and 3.3% disagreed. Since the percentages of those that disagreed and were neutral is very low, it can be concluded that small and medium enterprises play a major role in building a strong manufacturing sector that could contribute significantly to economic growth and competitiveness.

These results are in agreement with the findings of Warwick (2013)'s study of OECD countries on new initiatives and trends beyond industrial policy that put emphasis on the contribution of SMEs and the informal market as backbones for the advancement of the manufacturing sector and the achievement of economic growth (Warwick, 2013).

5.9.9 University-Industry Linkages for effective NSI

Research Question asked by the study is whether University-Industry linkage one of the characteristics of an effective National System of Innovation? The studies are resonating well with work done by scholars like Liew, Shahdna, & Lim, (2013) who posited that the nature of university – industry collaboration is dependent on, its impact in the market, its human capital and talent pool the university might provide to industry. They further went on to say that this collaboration comes in both traditional form of engagement which looks at universities sending its students for internships with industry & industry making use of university publications to make informed decisions, improve processes & products and the holistic form of engagements where both establish joint industry partnership & research consultancies and IPR sharing and licensing (Liew, Shahdna, & Lim, 2013).

Table 5. 17: University -Industry linkages for effective NSI

University - Industry linkages as one of the characteristics of an effective NSI					
		Frequency	Percent	Valid Percent	Cumulative Percent
	Disagree	3	2.4	2.4	3.3
	Neutral	12	9.8	9.8	13.0
	Agree	25	20.3	20.3	33.3
	Strongly Agree	82	66.7	66.7	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Results in Table 5.17 above indicate that having a well-defined university-industry linkage within an innovation system makes it effective. This is from the opinions of the respondents interviewed. This is confirmed by the high percentage of those that strongly agreed (66.7%) and mere agreed (20.3 %) to the statement that “well defined university industry linkage” is one of the initiatives needed to develop an effective National System of Innovation that is economically competitive, with 9.8% undecided and 2.4% disagreeing.

5.10 Namibia and Botswana STI policy Frameworks and Strategies

This section answers Research Questions 1.2.2, & 1.2. 5 of the main study including the sub questions 6.1 and 6.2.

Research Questions 2: What are the characteristics of Namibia and Botswana’s innovation policies? (5) What are the challenges encountered by Namibia and Botswana in implementing their STI policies and strategies?

Development of coherent policies in developing countries like Namibia and Botswana is challenged by the phenomena of policy borrowing, from developed nations that have managed their national systems of innovation well. Unfortunately this borrowing is done without making an in-house environmental scanning to ascertain whether the environment in which the borrowed policy was developed is similar to the country adapting such policy and whether it will be applicable (Ezell & Atkinson, 2010). Considering this, caution needs to be exercised during the process of development of these coherent polices to avoid a scenario of borrowing a good policy that has worked well in Finland but which might not be suited to the needs of either Namibia and Botswana.

Innovation related policies in both Namibia and Botswana lack coherence due to the fragmented nature of policies meant to address innovation (UNESCO, 2016). Although, the National Research Science and Technology Policy of Namibia invokes the importance of innovation as a vehicle for economic competitiveness, the industrial policy on the other hand puts emphasis on innovation through value addition for realization of the Growth at Home Strategy (Ministry of Higher Education Vocational Training Science & Technology, 1999) and (Ministry of Industrialisation, Trade & SME Development, 2012b).

Table 5. 18: Respondents ranking on the existence of coherent policies

Coherent Policies					
		Frequency	Percent	Valid Percent	Cumulative Percent
Coherent Policies	Strongly Disagree	1	.8	.8	.8
	Disagree	4	3.3	3.3	4.1
	Neutral	19	15.4	15.4	19.5
	Agree	42	34.1	34.1	53.7
	Strongly Agree	57	46.3	46.3	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Results from Table 5.18 above show that rankings of respondents on the question posed: "What are the characteristics of Namibia and Botswana's innovation policies?" In response, 46.3% of the respondents strongly agreed, followed by 34.1% who agreed that existence of coherent STI policies is vital for Namibia and Botswana.

5.10.1 Removing barriers to innovation and entrepreneurship

In the Namibian context, it can be decided from the Vision 2030 that innovation and entrepreneurship are some of the critical attributes for a knowledge-based society. This attribute saw a change in the education system for Namibia to shift from the traditional pattern of imparting large quantities of information to a more focused approach where learners/students were given learning competencies that enabled them to adapt to the dynamic environment (Government of the Republic of Namibia, 2004) . The other barriers to innovation and entrepreneurship culture are, trade, fiscal and procurement related. It is that duty of government to ensure that regulations are in place to support emerging innovators and entrepreneurs such as protecting them from competition from multinational companies, provision of tax to SMEs relief, provision of startup capital and procurement preferences to be given to entrepreneurs.

Table 5. 19: Removing barriers to innovation and entrepreneurship

Removing barriers to innovation and entrepreneurship					
		Frequency	Percent	Valid Percent	Cumulative Percent
Removal of barriers to innovation	Strongly Disagree	2	1.6	1.6	1.6
	Disagree	9	7.3	7.3	8.9
	Neutral	31	25.2	25.2	34.1
	Agree	32	26.0	26.0	60.2
	Strongly Agree	49	39.8	39.8	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Table 5.19 above shows the results on how the respondents reacted to the removal of barriers to innovation and entrepreneurship as a key obstacle hindering Namibia and Botswana from developing STI policies and strategies. Furthermore, the results indicated that 39.8% of the respondents strongly agree and 26% only agree that removal of barriers through creation of interventions that promote the engagement of innovators and entrepreneurs to contribute to economic growth and wealth creation.

Audretsch, Falck, Heblich, & Lederer, (2011) suggested that building strong linkages between higher education institutions and industry as well as strengthening public and private sector linkages, mobility of researchers, and provision of dedicated funding to innovation and entrepreneurship would lead to a national culture of innovation and entrepreneurship that promotes job creation and socio-economic development. Furthermore, Drucker (1985) also agrees that national innovation and entrepreneurial culture has transformed economies of America and Western Europe through the removal of barriers that hinder the development of innovation and entrepreneurial cultures.

5.10.2 Enterprise engagement in skills formation and innovation

The participation of the private and informal sectors through the engagement of enterprises in the skills formulation and innovation development should be considered as a key characteristic in informing STI development.

Enterprises that participate in skills development institutions like vocational training centers through partnerships in allowing students to do internship/apprenticeship at these enterprises as well as participating in curriculum development to ensure their needs are addressed help in giving practical skills to the participants. The job of policy makers is to ensure that enterprises are consulted during the policy formulation stage. The NRST policy for Namibia has in its S&T mission the following statement that supports enterprise engagement in skills formation for innovation:

"facilitating the development of Namibian citizens and enterprises through the provision of up-to-date technical advice, business support and S&T extension services and the maintenance of the critical core of technical competencies in the country with the skills and know-how needed by the society for the efficient management of S&T resources and assets" (Ministry of Higher Education Vocational Training Science & Technology, 1999,).

The STI policy for Botswana lacks explicit objectives and strategies that clearly articulate the involvement of enterprises in skills formation for innovation. (Ministry of Infrastructure, Science and Technology, 2011).

Table 5. 20: Enterprise engagement in skills formation and innovation

Enterprise engagement in skills formation and innovation					
		Frequency	Percent	Valid Percent	Cumulative Percent
Enterprise engagement in skills formation & innovation					
	Disagree	11	8.9	8.9	10.6
	Neutral	29	23.6	23.6	34.1
	Agree	44	35.8	35.8	69.9
	Strongly Agree	37	30.1	30.1	100.0
	Total	123	100.0	100.0	

Source: Primary Data

The study asked the views of respondents on the matter and the results in Table 5.20 above shows the responses with 35.8% agreeing and 30.1% strongly agreeing that if enterprises are engaged in the skills formulation exercise, starting with the curriculum development, internship & skills assessment to the innovation development process (idea generation, concept development, launching, feasibility, testing, incubation, prototyping and product development) it would lead to innovation policies that meet the demands of both enterprise policy makers and end-users.

5.10.3 Enhanced institutional/ partnerships with companies and communities

Enhanced collaboration among institutions and companies is good for scientific research and has an impact on the publication output of a university, hence must be encouraged (Edquist, 1997). From the government perspective, the partnership creates an environment where universities/industries and communities get integrated as one system in the policy development process. Lee (1999) posits that universities and industries both benefit from such collaborations such that industry will have a faster access to the new discoveries of universities whereas university researchers have access to equipment and research funding from industry.

Table 5. 21: Enhanced institutional/ partnership with companies and communities

Enhanced institutional linkages/partnerships with companies and communities					
		Frequency	Percent	Valid Percent	Cumulative Percent
Enhanced institutional linkages					
	Disagree	7	5.7	5.7	6.5
	Neutral	31	25.2	25.2	31.7
	Agree	41	33.3	33.3	65.0
	Strongly Agree	43	35.0	35.0	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Table 5.21 above shows 35% of the respondents strongly agree whilst 33.3% agree that having enhanced institutional linkages or creation of partnerships with companies and communities in the development and implementation of STI policies and strategies reduces the risk of not addressing the needs of companies and communities in the policies. Therefore, it is imperative that such institutional linkages with companies and communities be enhanced during policy development and implementation.

5.10.4 Strong University/Industry Linkages

The strength of university – industry collaboration is dependent on the engagements and partnerships supported by a critical mass of skilled human capital and a large talent pool from university with ability to provide new knowledge needed by industry to innovate and commercialize these innovations into products and services (Liew, Shahdna, & Lim, 2013). This collaboration comes in both, traditional form of engagement, which looks at internships and publications and the holistic form of engagements where both establish joint industry partnership & research consultancies and IPR sharing and licensing (Liew, Shahdna, & Lim, 2013). Furthermore, Su (2014) also posits that strong university- industry linkages are best created when scientists affiliated to research centres and institutes work with industry to transform industry challenges into solutions that will enhance the competitiveness of these industries (Su, 2014).

Table 5. 22: Strong University/ Industry Linkages

Strong University Industry Linkages					
		Frequency	Percent	Valid Percent	Cumulative Percent
Strong University/ Industry Linkages	Disagree	6	4.9	4.9	6.5
	Neutral	31	25.2	25.2	31.7
	Agree	45	36.6	36.6	68.3
	Strongly Agree	39	31.7	31.7	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Results in Table 5.22 above indicate that having a strong university-industry linkage within an innovation system, makes it effective as it benefits from the opinions of the respondents interviewed. This is confirmed by the high percentage of those that agreed (31.7%) and strongly agreed (36.2 %) to the statement that "strong university industry linkage" is one of the pillars to be considered when developing STI policies and strategies that support national systems of Innovation for economic competitiveness.

5.10.5 Dedicated funding system to R&D and Innovation

Namibia and Botswana have in the past developed national STI policies that supports the establishment of funding frameworks for R&D and innovation (CSIR, 2005); (NCRST, 2016). At SADC level both countries have signed and ratified the SADC Protocol on STI which complies all member states to spend 1% of their GDP on R&D by 2015 (SADC, 2008). However, delays in the establishment of dedicated funds have led to not meeting the set targets. Secondly, the Namibia National Research Science and Technology Fund proposed in the research science and technology Act, 2004 (Act 23 of 2004) has not been operationalized by the NCRST since 2013 (Government of the Republic of Namibia, 2004). Furthermore, the proposed funding of 0.3 percent of GDP as indicated in the NDP4 was not allocated to NCRST. Also from Botswana 's Research Science Technology and Innovation Policy and its tenth National Development Plan (NDP10) the government commits to achieve 1% expenditure of GDP to be spend on R&D and setup a national research and innovation fund but this commitment remains a challenge to the government of Botswana (Ministry of Infrastructure, Science and Technology, 2011).

Table 5.23 below shows the respondents' views on the given indicator: having a dedicated funding system to support R&D and Innovation leads to increased scholarly output in form of publications, strengthened linkages between university –industry, and production of prototypes that can be transformed in goods and services through commercialisation.

Table 5. 23: Dedicated funding system to support R&D and Innovation

Dedicated funding system to support R&D and Innovation					
		Frequency	Percent	Valid Percent	Cumulative Percent
Dedicated funding to support R&D	Strongly Disagree	1	1.6	.1.6	.1.6
	Disagree	4	3.3	3.3	4.9
	Neutral	30	24.4	24.6	28.3
	Agree	41	33.3	33.6	62.3
	Strongly Agree	46	37.4	37.7	100.0
	Total	122	100.0	100.0	
Total		123	100.0		

Source: Primary Data

Table 5.23 shows that respondents 37.7% strongly agreed and supports the establishment of dedicated funding systems for R&D and Innovation followed by 33, 3% of the respondents who also agreed with the statement. However, 24.4% of the respondents were undedicated as to whether Namibia and Botswana should dedicate funding systems for R&D and Innovation to have effective NSI that are efficient in delivering services to its stakeholders and customers. Whilst 4.9% of the respondents were in disagreement that having dedicated funding systems for R&D and Innovation lead to an effective NSI. Since the combined percentage of those that were neutral and those in disagreement was less than the strongly agree and agree percentages in the study.

Concluded that there is a need to establish a funding system to support R&D and Innovation in Namibia and Botswana to expand R&D and Innovation output and increase commercialization of research outputs, patents registration, and increased number of researchers and increased funding to support R&D and Innovation.

5.10.6 Namibia and Botswana innovation policies that stimulate national economic competitiveness

Botswana and Namibia have developed policies like the Industrial Policies, Agricultural Policies, Mining and Mineral beneficiation, Small Medium Enterprise Polices, Research Science, Technology and Innovation Policy (Botswana), Research Science and Technology Policy(Namibia), Energy Policy (Namibia) , Fisheries Marine and Aqua-Culture Policy (Namibia), Diamond Policies (Both) in National Development Plans (Vision 2030, Harambee Prosperity Plan & NDP5 for Namibia and Vision 2016 & NDP10 for Botswana) and Higher and Tertiary education Policies that support the stimulation national economic competitiveness. The table below presents results the respondents on sub question 6.2: To what extent has Namibia and Botswana implemented innovation policies that can stimulate national economic competitiveness?

Table 5. 24: Namibia and Botswana Innovation Policies that stimulate national economic competitiveness

To what extent has Namibia and Botswana implemented innovation policies that can stimulate national economic competitiveness?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Namibia - Botswana policies that stimulate Economic Development	Fairly	6	4.9	4.9	4.9
	Satisfactory	21	17.1	17.1	22.0
	Good	28	22.8	22.8	44.7
	Very Good	68	55.3	55.3	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Table 5.24 above indicates that 55.3% of the respondents said that Namibia and Botswana implemented their STI policies very well due to the availability and utilisation of natural endowments and the attributes mentioned above. These results agree with Porter's theory of the competitiveness of nations, using its four attributes: condition factors, demand conditions, related support industries & Firm Strategy, Structure and Rivalry (Porter, 1990).

5.11 Science, Technology, and Innovation for Economic Development

This section answers research question 1.2.4 and sub questions 7.1 and 7.2 of the quantitative questionnaire presenting results on how the respondents reacted to the following statements suggested to be critical inputs needed by Namibia and Botswana's material base and wealth creation. (1) Availability of shelter, water & sanitation, healthcare and a responsive education system to industry demands. (2) Rich in mineral resources (Uranium, Diamond, Copper and Gold). (3) Contribution of Tertiary Industries to the economy (Meat and Fish exports, beverages such as Windhoek Lager in the case of Namibia, mineral processing, and value addition, Tourism, Textile and Services). (4) Contribution of Primary Industries to the economy (mining, agriculture, and energy production), (5) Education System at all levels (Basic, TVET & Higher Education). (6) The role played by the Foreign Policies as gateways to attract Foreign Direct Investment. Results from

5.11.1 Shelter, Water, Sanitation, Health Care & Education System

Provision of shelter to the citizens, portable drinking water, sanitation, good health care system and an education system that responds to industry demand are regraded as factor conditions needed by Botswana and Namibia to develop effective NSIs driven by science, technology and innivation to meet the key aspirations of the African Union Agenda 2063 and the Sustainable Development Goals (SDGs) of 2030. The road towards knowledge based industrailised nations requies an enivornment where these basic aminuties are provided to the population as stipulated in the SDGS.

Table 5. 25: Shelter, Water, Sanitation, Health Care & Education System

Shelter, Water, sanitation, health care& education system					
		Frequency	Percent	Valid Percent	Cumulative Percent
Factor conditions	Strongly disagree	2	1.6	1.6	1.6
	Disagree	7	5.7	5.7	7.3
	Neutral	21	17.1	17.1	24.4
	Agree	38	30.9	30.9	55.3
	Strongly Agree	55	44.7	44.7	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Results from table 5.25 indicate that 44.7% of the respondents strongly agree that availability of shelter, water, sanitation good health care system accompanied by a good education system enables a country to innovate and create wealth, which would increase the GDP and improve knowledge & technology output due to their knowledgeable workers living in a healthy environment and not being subjected to risks of contracting diseases caused by poor sanitation and water supply. 30.6 % of the respondents also agreed with the above statement.

However, there were some respondents who neither agreed nor disagreed with the above statement. These constituted 17.1% of the total respondents (N=123) and 5.6% and 1.6% disagreeing and strongly disagreeing with the statement. The neutral and disagreeing percentages were very small as compared to those that strongly agreed and agreed to statement respectively, which implies that the neutral and disagreeing responses could be rejected.

5.11.2 Rich Mineral Resources (Uranium, Diamond, Copper & Gold)

Namibia and Botswana are rich in the following mineral resources: Uranium, Diamonds, and Copper & Gold. The respondents were asked to confirm whether the bearing of these mineral resources by the two countries has a bearing on improving their material base and wealth creation.

Table 5. 26: Rich Mineral Resources (Uranium, Diamond, Copper & Gold)

Rich Mineral Resources (Uranium, Diamond, Copper & Gold)					
		Frequency	Percent	Valid Percent	Cumulative Percent
Factor conditions	Strongly Disagree	2	1.6	1.6	1.6
	Disagree	2	1.6	1.6	3.3
	Neutral	24	19.5	19.5	22.8
	Agree	47	38.2	38.2	61.0
	Strongly Agree	48	39.0	39.0	100.0
	Total	123	100.0	100.0	

Source: Primary Data

The results from the Table 5.26 above show that the respondents strongly agree and fairly agree to the statement with 39% strongly agreeing and 38, 2% merely agreeing. 19.5% were neutral and 1.6% strongly disagreed. It can therefore, be deduced from the explanation above that indeed richness in mineral resources is a good contributor to the countries' GDP as confirmed from chapter 3 under the economic drivers. Mining comes out as a big contributor to the national GDPs of Namibia and Botswana.

5.11.3 Tertiary Industries

Namibia and Botswana's tertiary industry contributes towards wealth creation through revenue accrued from wholesale & retail trade chain stores that operate franchises across the countries, hospitality industry from hotels, lodges & restaurants, transport & logistics where connections via road networks like the trans-Caprivi and trans-Kalahari roads networks, the dry port availed to the Government Botswana by the Government of Namibia at the Port of Walvis Bay to be used as a source of entry and exist of goods destined for Botswana, Real estate and business services as well as information communication technology through the sale of software and mobile applications. Tourism is another sector with potential of growing the tertiary industry and create employment. Table 5.27 below shows the respondent's rankings on Tertiary industries (wholesale & retail trade, hospitality, transport & logistics, Tourism, Real estate and business services).

Table 5. 27: Tertiary Industries

Tertiary Industries (wholesale, retail trade; hospitality, transport…)					
		Frequency	Percent	Valid Percent	Cumulative Percent
Tertiary Industries	Disagree	3	2.4	2.4	2.4
	Neutral	26	21.1	21.1	23.6
	Agree	42	34.1	34.1	57.7
	Strongly Agree	52	42.3	42.3	100.0
	Total	123	100.0	100.0	

Source: Primary Data

. Table 5.27 above presents the results of the respondents on the above statement. It can be deduced from the table that the majority, with a combined percentage of 76, 7% agreed that indeed the tertiary industry is a major contributor towards wealth creation.

5.11.4 Primary Industries

Primary industries play a major role in STI wealth creation in Namibia and Botswana as indicated in the Table 5.28 above. Namibia and Botswana are rich in the following mineral resources: Uranium, Diamond, Copper and Gold. The agricultural sector mainly focused on livestock and crop farming and Fisheries focused on marine and aquaculture.

Table 5. 28: Primary Industries

Primary Industries (agriculture, mining and fisheries)					
		Frequency	Percent	Valid Percent	Cumulative Percent
Primary Industries	Strongly Disagree	3	2.4	2.4	2.4
	Disagree	6	4.9	4.9	7.3
	Neutral	27	22.0	22.0	29.3
	Agree	49	39.8	39.8	69.1
	Strongly Agree	38	30.9	30.9	100.0
	Total	123	100.0	100.0	

Source: Primary Data

The results from the table above show that the respondents strongly agree and fairly agree to the statement with 39% strongly agreeing and 30.1% for merely agreeing. 19.5% for neutral and 1.6% for both strongly disagree and agree. Therefore, it can be deduced from the explanation above that indeed richness in mineral resources is a good contributor to the countries' GDP as stated in chapter 3. Under the economic drivers, mining and quarrying comes out as a big contributor to the national GDPs of Namibia and Botswana.

Table 5. 29: Education Systems (Basic, Secondary, TVET and Higher Education)

Education System (Basic, Secondary TVET and higher education)					
		Frequency	Percent	Valid Percent	Cumulative Percent
Education System	Strongly Disagree	2	1.6	1.6	1.6
	Disagree	9	7.3	7.3	8.9
	Neutral	29	23.6	23.6	32.5
	Agree	43	35.0	35.0	67.5
	Strongly Agree	40	32.5	32.5	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Table 5.29 above presents the results from the respondents on whether having a good education system is an input towards STI wealth creation. The respondents who participated in the interviews unanimously agreed that a good education system that is well managed, leads to the development of knowledge workers to innovate and produce more goods and services and in return generate wealth. The study further found that 43 out of 123 respondents agreed (35. 0% followed by 32.2% strongly agreed with the statement "Education System (Basic, secondary, TVET and High Education)" as a good ingredient for Namibia and Botswana STI material base and wealth.

Table 5. 30: Foreign Policy (FDI)

Foreign Policy (FDI)					
		Frequency	Percent	Valid Percent	Cumulative Percent
Foreign Policy	Strongly Disagree	2	1.6	1.6	1.6
	Disagree	8	6.5	6.5	8.1
	Neutral	26	21.1	21.1	29.3
	Agree	40	32.5	32.5	61.8
	Strongly Agree	47	38.2	38.2	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Table 5.30 above shows the results on how the respondents responded to the question on whether Foreign Policy triggers Foreign Direct Investment (FDI). 38.2 % of respondents strongly agree and 32.5% only agree that Foreign Policies that have a component of STI are likely to easily attract FDI. The Kenyan and South African foreign policies are some such examples that draw huge sums of money for research and development with international programmes. This is due to their bilateral engagements with the European Union on initiatives like the cooperation of Finland and South Africa (COFISA). Other linkages are with the Association of Commonwealth Universities (ACU) & its network of CAAST-NET plus where Kenya and South Africa partners with countries in Europe. Also, the Research and Innovation Network for Europe and Africa (RINEA) under the Horizon 2020 for the purpose of strengthening cooperation research and innovation to tackle global challenges faced by Africa and Europe.

5.11.5 To what extent can science, technology, and innovation (STI) contribute to Namibia and Botswana's material base and wealth?

This section responded to question 7.2 where the respondents gave their views on the magnitude of STI in contributing to Namibia and Botswana's material base and wealth creation. The results from Table 5.30 below show that 59.3% of the respondents indicated that if Namibia and Botswana leverage on their STI resources they are likely to develop their material base and wealth. This was followed by 26.6% that indicated that high STI leveraging leads to development of a material base and wealth with 12.2% moderate and only 1.6% giving a low rating.

Table 5. 31: STI contribution to Namibia and Botswanan's economic development

To what extent can STI contribute to Namibia and Botswana's economic development					
		Frequency	Percent	Valid Percent	Cumulative Percent
STI contribution to economic development	low	2	1.6	1.6	1.6
	Moderate	15	12.2	12.2	13.8
	High	33	26.8	26.8	40.7
	Extremely high	73	59.3	59.3	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Table 5.31 above indicates that the extent to which STI contributes to Namibia and Botswana‘s economic development is extremely high with a score of 59.3%. This means that the contribution of STI to Namibia and Botswana's economic development and achieving of national goals was high. These results are supported by scholars like (Mytelka, 2016); (Geuna.A, Salter, & Steinmueller, 2003); (Kates, Paris, & Lelserwitz, 2005) and (Mugabe, 2000) who advocated for sustainable use and management of natural endowments as tools to realise objectives for their national developmental agendas.

The STI policies from both countries have guiding principles that support the above, but the challenge is in the implementation phase as these policies are not accompanied by implementation plans with clear monitoring and evaluation. Secondly, lack of annual audits on the performance of STI in the wealth creation was identified as another challenge.

5.11.6 How science and technology resources are linked to Namibia and Botswana's Economic competitiveness?

This section provides responses from the respondents on the views on how Namibia and Botswana's STI resources are linked to economic competitiveness using the following indicators: (1) % of GDP expenditure on R&D; (2) % of GDP on Innovation, Research and Development; (3) Number of Technology Transfer and adaptation projects; (4) Capacity building of scientific personnel and (5) Active participation of scientists in the diaspora.

Table 5. 32: Percentage of GDP expenditure on R&D

Percentage of GDP expenditure on R&D					
		Frequency	Percent	Valid Percent	Cumulative Percent
Percentage of GDP expenditure on R&D	Strongly Disagree	1	.0. ,7	0.7	0..7
	Disagree	5	4.1	4.1	6.8
	Neutral	14	11.4	11.4	18.2
	Agree	44	35.8	35.8	54.0
	Strongly Agree	59	48.0	48.0	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Table 5.32 presents the results on how the respondents reached to the following indicator: "% of GDP expenditure on R&D" as a resource linked to economic competitiveness. The table above further shows that 48% of the respondents strongly agreed and 35.8% agreed that an increase in the % of GDP expenditure leads to a high score on the World Economic Competitive ranking. The results are also confirmed further by the Global Innovation Index report of 2016 that the economic competitiveness of nations is influenced by their gross expenditure on R&D as a percentage of GDP (Dutta, Soumitra; Lanvia, Bruno; Wunsch-Vincent, Sacha, 2017). Evidence from countries like Finland, Singapore, South Africa and Mauritius suggests that countries that spend high on GERD are also ranked amongst the top countries that are economically competitive.

Namibia and Botswana, have made provision for increasing their gross expenditure on R&D as a percentage of GDP in their STI policies in accordance with the international obligations which both countries are party to such as the AU STISA 2014-2024 and the commitment in the SADC Protocol on Science Technology and Innovation which member states agreed to spend at least 1% of their GDP towards R&D (African Union, 2014) and (SADC, 2008). Currently Namibia's expenditure on R&D stands at 0.35% according to the R&D survey conducted by NCRST in collaboration with NSA in 2016 (NCRST, 2017). Whilst the national vision 2016 of Botswana set a target of 2% of Botswana's GDP to be spent on R&D. However, this target was not realised as the country's R&D expenditure during the 2013/14 financial year was only standing at 0.54% (UNESCO, 2013).

5.11.7 Percentage of Innovation, Research and Development

For Namibia and Botswana to compete favourably with these countries in terms utilisation of their innovative, research & development capabilities, they need to build and strengthen innovation culture through motivating, investing in science technology and innovation to support the researchers and innovators intending to conduct innovative research and enhance their home-grown technologies for rapid transformation of their economies to knowledge based and attain competitiveness. The table below shows the respondents opinion on the indicator

Table 5. 33: Percentage of Innovation, Research and Development

Percentage of Innovation, Research and Development					
		Frequency	Percent	Valid Percent	Cumulative Percent
	Disagree	5	4.1	4.1	5.8
	Neutral	18	14.6	14.6	20.7
	Agree	42	34.1	34.1	55.4
	Strongly Agree	58	47.2	4.7.2	100.0
	Total	123	100	100.0	
Total		123	100.0		

Source: Primary Data

Table 5.33 presents the results on how the respondents reacted to the following indicator: % of innovation, research and development output as a resource linked to economic competitiveness. The table further shows that 47.2 % of the respondents strongly agreed and 34.1% agree that an increase in innovation, research and development output leads to high economic competitiveness. This is confirmed further by the GII report of 2016 which contains information on successful countries like Korea, Germany, South Africa and Mauritius in applying their innovation, research and development capabilities to become top leaders in manufacturing and supply of products and services that end up in Namibian and Botswana markets. (Dutta, Soumitra; Lanvia, Bruno; Wunsch-Vincent, Sacha, 2017).

5.11.8 Technology Transfer and Adaptation

In the context of developed countries, technology transfer is viewed as a process in which research centres / universities collaborate with industry to create opportunities for developing countries to access technologies to benefit the general public. However, in developing countries like Namibia and Botswana the acquired technologies must be adapted to suit the local conditions (United Nations, 2014). This could also mean transferring knowledge or technical skills on how to operate a certain technology designed for specific use or sector and how to make it work in a different environment. For example, Namibia acquired threshers from India to use in its agricultural sector; these threshers were initially designed for rice but the Rural Development Center under the Ministry of Agriculture managed to adapt them for threshing pearl millet or mahangu instead of maize (Ministry of Agriculture, Water and Forestry, 2014).

Table 5. 34: Technology Transfer and Adaptation

Number of Technology Transfer and adaptation					
		Frequency	Percent	Valid Percent	Cumulative Percent
Technology Transfer	Strongly Disagree	1	.8	.8	.8
	Disagree	6	4.9	4.9	5.7
	Neutral	26	21.1	21.1	26.8
	Agree	32	26.0	26.0	52.8
	Strongly Agree	58	47.2	47.2	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Table 5.34 above shows that 47.2% and 26% strongly agree and agree respectively that technology transfer and adaptation increase the research and innovation index of nations. Therefore, for Namibia and Botswana to be competitive they need to adapt technologies transferred from highly industrialised countries like Germany and the UK. Technology transfer and adaptation comes with many benefits to a national system of innovation, not limited to skills transfer and knowledge brokerage participation, countries can leverage on the longtime networks created between a consortium of research institutions and the knowledge of users (OECD, 2015).

5.11.9 Capacity building of Scientific Personnel

Studies have shown that countries that have invested in educating their scientific personnel through Science Technology Engineering and Mathematics (STEM) programmes have a competitive advantage over the others in developing economic competitiveness. Taking a country without any minerals to export like Singapore as an example of a country that has invested heavily in developing its capacity of scientific personnel, the country managed to generate a large pool of knowledge workers in scientific areas hence the higher ranking above Namibia and Botswana on the Economic Competitiveness.

Therefore, this prompted the governments of Namibia and Botswana to commit to improve their ranking on the world economic competitiveness forum and global innovation index by introducing interventions such as committed to increase funding in research and development for industrialization, economic development and sustainable development as well as equipping their people with requisite scientific, technical and vocational skills needed to innovate and create jobs aimed at improving and strengthening their economic competitiveness.

In order to realize the above, both countries took a proactive move to establish dedicated S&T oriented higher education institutions in the name of the Namibia University of Science & Technology (NUST) for Namibia and the Botswana International University of Science and Technology (BIUST) to facilitate such initiative of developing capacity in STEM fields. Also, the University of Namibia has introduced new programmes like Medicine to train doctors, Engineering & ICT for all engineering and ICT disciplines, Veterinary Medicine, Dentistry and Architectural sciences to produce graduates that are relevant to the contemporary global market.

Table 5. 35: Capacity building of scientific personnel

Capacity building of scientific personnel					
		Frequency	Percent	Valid Percent	Cumulative Percent
Capacity Building	Strongly Disagree	1	0.8	0.8	0.8
	Disagree	7	5.7	5.7	6.5
	Neutral	17	13.8	13.8	20.3
	Agree	40	32.5	32.5	52.8
	Strongly Agree	58	47.2	47.2	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Results in the Table 5.35 above also confirm the assumption mentioned above with 47.2% strongly agreeing, followed by 32.5% agreeing that building capacity of scientific personnel will put Namibia and Botswana at a comparable level with countries like Singapore and Finland.

5.11.10 Active participation of scientists in the diaspora

Participation of scientists in the diaspora in national developmental issues is a positive thing which must be encouraged as it strengthens scientific cooperation opportunities that are of value in countries of origin. The benefits range from funding, to provision of hi-tech equipment to research laboratories (Tejada, 2012).

At the AU level, African scientists in the diaspora network of expert is regarded as one of the structures that are consulted for expert advice during the formulation of policies like the STISA 2024 and many other instruments developed by the Directorate of Human Resources, Science and Technology (HRST) to contribute towards the realization of the agenda 2063 (African Union, 2014). The other platforms where services of scientists in the diaspora have been benefited the African Continent is in their active role played in providing advice to governments through academies of sciences (Third World Academy of Sciences (TWAS), African Academy of Sciences as well as national academies where they exist) to assist with mobilizing resources (financial and institutional) to advance the capacity of STI in the countries of origin. It is therefore, imperative for Namibia and Botswana to consider maximum utilisation of its scientists in the diaspora to benefit from the knowledge and networks needed for competitiveness and economic development.

Table 5. 36: Active participation of scientists in the diaspora

Active participation of scientists in the diaspora					
		Frequency	Percent	Valid Percent	Cumulative Percent
Active participation of scientist in the diaspora	Strongly Disagree	2	1.6	1.6	1.6
	Disagree	3	2.4	2.4	4.1
	Neutral	24	19.5	19.5	23.6
	Agree	39	31.7	31.7	55.3
	Strongly Agree	55	44.7	44.7	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Table 5.36 above shows results that a combined majority in percentage amounting to 77.4% strong agreed and agreed that scientists in the diaspora could make a meaningful contribution to the country's economic competitiveness if a conducive environment is put in place for them to actively participate in the research, innovation and development initiative that leads to economic competitiveness.

5.12 Challenges in Implementing STI policies and strategies

This section provides responses from the respondents on the views on the challenges faced by Namibia and Botswana in implementing its STI policies and Strategies, using the following challenges: (1) lack of adequate supportive infrastructure. (2) STI not embedded into national visions of the country. (3) STI not seen as a tool for economic growth and development. (4) STI budgets channeled through ministries of education and planning and (5) Centralisation of STI budgets.

5.12.1 Lack of adequate supportive infrastructure

The implementation of STI policies and strategies in developing countries like Namibia and Botswana is hampered by lack of adequate supportive infrastructure as most of the equipment at the disposal of the scientists is either malfunctioning or outdated. This creates a dependency on the advanced laboratories in South Africa or Europe to help even with simple analysis leading to many specialised scientists becoming demotivated.

For Namibia this challenge is partly historical, due to the colonisation by South Africa for many years. For example, STI legislation in force till 2004 was the scientific and industrial research Act, 1988 that was also applicable to South West Africa (Gazette, Government, 1988). The country was also without a university until 1992 when the academy of higher education was transformed into the University of Namibia (Government of the Republic of Namibia, 1992).

Table 5. 37: Lack of adequate supportive infrastructure

Lack of adequate supportive infrastructure					
		Frequency	Percent	Valid Percent	Cumulative Percent
Lack of adequate supportive infrastructure	Strongly Disagree	3	2.4	2.4	2.4
	Disagree	5	4.1	4.1	6.5
	Neutral	7	5.7	5.7	12.2
	Agree	36	29.3	29.3	41.5
	Strongly Agree	72	58.5	58.5	100.0
	Total	123	100.0	100.0	

Source: Primary Data

The results from Table 5.37 above revealed that 58.5% of the respondents strongly agreed and 29.3% only agreed to the challenge of lack of adequate supportive infrastructure as a hindrance in increasing research & development output which poses a challenge in the implementation of STI policies. These results agree with the findings of Namibia’s R&D survey on access and availability of adequate infrastructure to support R&D, where the report revealed that Namibian research institutions are challenged by lack of adequate infrastructure (NCRST, 2017).

To overcome the challenges of lack of adequate infrastructure to support R&D in Namibia and Botswana, the study suggests the following interventions to be undertaken:

(a) A new policy on acquisition, usage of specialised equipment be developed, managed by the NCRST and BITRI

(b) Encourage the sharing of equipment among universities and research institutes

(c) NCRST and BITIRI develop national service laboratories that could be located at universities, where industries could bring their samples for analysis.

(d) Promote collaborative research groups across universities and research institutes when dealing with research which transboundary.

5.12.2 STI not embedded in the national Visons of the Countries

Tables 5.38 & 5.39 below show results on how respondents reacted to the challenge of not having STI embedded in the national visions of the country. This omission normally leads to STI always considered as a periphery as compared to sectors like trade. It must be understood that most successful countries like Finland, Singapore, Malaysia, and Korea have put STI at the core of their national vision statements as a key driver for economic growth and development.

Table 5. 38: STI not embedded in the national visions of the countries

If STI is not embedded in the national vision of the country					
		Frequency	Percent	Valid Percent	Cumulative Percent
STI not embedded in national visions	Strongly Disagree	2	1.6	1.6	1.6
	Disagree	5	4.1	4.1	5.7
	Neutral	17	13.8	13.8	19.5
	Agree	37	30.1	30.1	49.6
	Strongly Agree	62	50.4	50.4	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Table 5. 39: STI not seen as a tool for economic growth and development

STI not seen as a tool for economic growth and development					
		Frequency	Percent	Valid Percent	Cumulative Percent
STI not seen as a tool for economic development	Strongly Disagree	1	.8	.8	.8
	Disagree	6	4.9	4.9	5.7
	Neutral	15	12.2	12.2	17.9
	Agree	39	31.7	31.7	49.6
	Strongly Agree	62	50.4	50.4	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Results in Tables 5.38 & 5.39 show that 50.4% strongly agree and 30.1% agree that not embedding STI in the national visions of the country is a challenge in the implementation of STI policies as it will always be placed on low priority of development and funding.

Secondly, Table 5.39 also shows results on how respondents ranked the views pertaining to not regarding STI as a tool for economic growth and development by 50.4% strongly agreeing and 31.7% agreeing respectively. Linking the results to the current situation of the two countries under review, one concludes that although at sector level, strong emphasis and articulation of STI visions is done comprehensively, there is still a lack of linkages between national STI visions and national developmental visions.

For Example, Namibia’s vision 2030, and its medium-term plans (NDPs and the Harambee Prosperity Plan) does not have explicit goals that have a specific focus on the application of STI to address developmental areas.

According to this study, the invisibility for STI is brought about its current configuration and placement. It would be best if the STI portfolio is placed in a non-sectorial organ of state like the office of the President or the Office of the Prime Minister for better policy coherence and coordination of the NSI. This approach has worked in countries such as Rwanda and Finland where STI coordinating agencies are placed in either the Office of the President or Prime Minister respectively.

5.12.3 STI budgets channelled through the ministry of education and planning

Countries where STI budgets are channeled through ministries of planning and education face a challenge of STI porgrammes not edquately funded. Namibia and Botswana’s STI budgets are lower than the education budgets making it difficult to enable impactiful research that guides decision makers to the develop evidence based STI policies. The Table 5.40 below shows the results of the respondents on whether channelling STI budgets through sector ministries like education and planning would have impact in the implementation of STI policies.

Table 5. 40: STI budgets channelled through the Ministries of Education and Planning

STI Budgets channeled through ministries of education and planning					
		Frequency	Percent	Valid Percent	Cumulative Percent
Channeling STI budgets through planning and education ministries	Disagree	3	2.4	2.4	2.4
	Neutral	23	18.7	18.7	21.1
	Agree	40	32.5	32.5	53.7
	Strongly Agree	57	46.3	46.3	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Table 5.40 above results shows that 46.3% of the respondents strongly agree and 32.5 % agree to the statement that the channeling of STI budgets through ministries of education and planning in the past has caused a challenge in the smooth implementation of STI policies by Namibia and Botswana. However, this has not been the practice on the ground as for over the past years budgetary allocations to STI in Namibia and Botswana have been channeled through the ministries of education and planning due to the placement of the STI portfolio under those ministries. This has resulted in under funding of the STI portfolio as the demands of basic education and those of planning were seen to be high and leaving less funding directed to STI.

Secondly, other sectors such as industry, trade, mining, energy, and water also posed a challenge to the STI budgets as these sectors equally competed for resources to finance their R&D activities due to lack of dedicated ministries for STI in both countries like it is with countries such as South Africa and Lesotho. However, this has slightly changed with the creation of the two ministries in both countries with the responsibility of STI (Ministry of

Higher Education, Training and Innovation for Namibia and the Ministry of Higher, and Tertiary Education, Science and Technology for Botswana) still the actual budget allocated to STI is low as the bulk goes to fund vocational training and higher education.

5.12.4 Centralized national STI budgets

Centralisation of STI budgets has led to countries like South Africa and Mauritius developing their NSI which are stronger compared to Namibia and Botswana. This has come with many opportunities for collaboration between universities and industry in the generation, procurement, acquisition and adoption of knowledge and technology which supports the promotion of creating new start-up companies. Finally, it ensures that national R&D agendas are appropriately funded and duplications in funding R&D is avoided.

Namibia and Botswana are faced with a challenge of having a fragmented budgetary allocation to STI due to lack of a centralized STI budget, even though provision is made for enabling legislative instruments that establish STI implementing agencies in both countries. Their STI budgets is scattered over various ministries like Industrialisation, agriculture, water, education, higher education (university & vocational training colleges), mines & energy, environment, and health even in developed countries like UK and the USA.

Table 5. 41: Centralized national STI budgets

Centralize national STI budgets					
		Frequency	Percent	Valid Percent	Cumulative Percent
Centralise national STI budgets	Strongly Disagree	2	1.6	1.6	1.6
	Disagree	6	4.9	4.9	6.5
	Neutral	14	11.4	11.4	17.9
	Agree	38	30.9	30.9	48.8
	Strongly Agree	63	51.2	51.2	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Table 5.41 shows results that the majority of respondents interviewed strongly agree (51.2%) and agree (30.9%) with that having a centralized national STI budget would ensure a coordinated approach that leads to the realisation of set targets in the national research agendas of both countries.

5.13 Solutions to improve STI policies and strategies

This section answers question 6 of the study and sub question 9.1 of the questionnaire (. Furthermore, the section provides responses from the respondents' views on the proposed solutions for improving STI policies and strategies for Namibia and Botswana: (1) Focus on emerging forms of innovations; (2) Connect users directly with knowledge creating firms; (3) Ensure policy harmonisation i.e. STI and Industrialisation policies; (4) Provide incentives to researchers and scientists; (5) close the gap in the innovation value chain; (6) Establish innovation networks; (7) Encourage the participation of SMEs in the innovation value chain; (8) Establish national R&D funds; (9) Develop centers of excellence for R&D in all key research priorities; (10) Human capital development and (11) Strong Political will.

5.13.1 Focus on emerging forms of innovation

The key contributors to the creation of emerging innovation in any given economy is the small and medium enterprises as they are responsible for growth, innovation, and development of new ideas and products to meet the demand for new investment and employment opportunities. Data from the Namibia SME policy shows that the estimated 33 700 SMEs in Namibia have a capacity to employ about 160 000 citizens (Ministry of Industrialisation, Trade & SME Development, 2016).

Table 5. 42: Focus on emerging forms of innovation

Focus on emerging forms of innovations					
		Frequency	Percent	Valid Percent	Cumulative Percent
Focus on emerging forms of innovations	Strongly Disagree	2	1.6	1.6	1.6
	Neutral	11	8.9	8.9	9.8
	Agree	31	25.2	25.2	35.0
	Strongly Agree	79	64.2	64.2	99.2
					100.0
	Total	123	100.0	100.0	

Source: Primary Data

Table 5.42 shows that a combined percentage of the respondents that strongly agreed and agreed to the initiative "Focus on emerging forms of innovations" adds up to 87.4% which is high enough to justify that focusing on emerging innovations and research areas will definitely improve Namibia and Botswana's STI landscape.

The author also agrees with findings of the study that SMEs are key contributors to emerging innovation necessary for business development and capable of promoting homemade technologies which supports the strategies under the Growth at Home Strategy (Ministry of Industrialisation, Trade & SME Development, 2012b).

5.13.2 Connect users with knowledge firms

Connecting users directly with knowledge creating firms reduces the delays caused by intermediaries in knowledge transfer. This initiative promotes a participatory approach where the knowledge user provides inputs to the manufacturing value chain as they will have direct interaction with the firms. Although both STI policies do not have explicit strategies of linking users to knowledge creating firms, there are other policies and strategies from the trade and industrialization ministries that make the provision for such initiatives of linking innovation users to knowledge firms in the business sector. Both countries' industrial policies and strategies have deliberate strategies for linking consumers with wholesalers (Ministry of Industrialization Trade & SME Development, 2012a) and (Botswana Government, 2014) respectively.

Table 5. 43: Connect users with knowledge firms

Connects users directly with knowledge creating firms					
		Frequency	Percent	Valid Percent	Cumulative Percent
Connect users with knowledge firms	Disagree	3	2.4	2.4	2.4
	Neutral	10	8.1	8.1	10.6
	Agree	26	21.1	21.1	31.7
	Strongly Agree	84	68.3	68.3	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Table 5.43 above shows how the respondents reacted to the infinitive. The results indicate that 68.3 % strongly agreed followed by 21.1 % who agreed on the necessity of connecting users directly with knowledge creating firms as a critical initiative for STI policy implementation.

13.3.3 Ensure policy harmonisation

The development of evidence based STI policies requires a thorough harmonisation process to ensure there are no duplications and overlaps. For example, Innovation in Namibia is addressed in many policies (Industrial policy, Agricultural policy, Research Science and Technology Policy of 1999 all deal with innovation in one or another). In Botswana as well, innovation is addressed under the STI policy, Industrial policy, Agricultural and mining policies making it difficult to measure the progress (Ministry of Higher Education Vocational Training Science & Technology, 1999). Therefore, policy harmonisation is very important in guiding countries to develop evidence based STI policies.

Table 5. 44: Ensure policy harmonisation

Ensure policy harmonisation i.e. STI and Industrialization policies					
		Frequency	Percent	Valid Percent	Cumulative Percent
Ensure policy harmonisation	Strongly Disagree	1	.8	.8	.8
	Neutral	11	8.9	8.9	9.8
	Agree	28	22.8	22.8	32.5
	Strongly Agree	83	67.5	67.5	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Results from Table 5.44 above shows a huge acceptance by respondents that strongly agreed (67.5%) that harmonisation of policies reduces duplications.

These results agree with the findings of the two reviews conducted by UNESCO Namibia and Botswana's research and innovation landscape at different times, which identified policy harmonisation as an important function needed by both countries to avoid duplications during policy implementation (UNESCO, 2013, 2016). The researcher believes that if harmonisation happened at the review stage it would result in the development of evidence-based policies.

5.13.4 Provide incentives to researchers and scientists

Provision of incentives to researchers and scientists is one mechanism to encourage more participation of these researchers and scientists in more research and generation of economically viable projects and addressing of the challenges faced by ordinary people in the street. An incentive system could attract best scientists and researchers to help develop a critical mass of PhDs and Post doctorial scientists and researchers needed by the countries to improve their economic competitiveness. Also, provision of tax incentives and grants to industry for joint R&D and innovative activities could also help boost research output. This could range from small credit lines advanced to industry for procuring knowledge from universities, who in return use the funds to further the R&D and innovation activities.

Table 5. 45: Provide incentives to researchers and scientists

Provide incentives to researchers and scientists					
		Frequency	Percent	Valid Percent	Cumulative Percent
Provide incentives to researchers	Disagree	1	.8	.8	.8
	Neutral	12	9.8	9.8	10.6
	Agree	29	23.6	23.6	34.1
	Strongly Agree	81	65.9	65.9	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Results in Table 5.45 above shows that 65.9% of the respondents strongly agreed and 23.6% agreed with the statement “Provide incentives to researchers and scientists” as solution to improve the STI policy implementation. Incentives to researchers and scientists through interventions like affiliation to research centers has led to increased output in the form of publications and discoveries. It has also allowed universities to build strong alliances with industry (Su, 2014). This role is made possible with the involvement of government through policy and implementation programmes that they provide to universities.

5.13.5 Close gap in the innovation value chain

Table 5.46 below shows results of the respondent views on whether narrowing the innovation gap will indeed help Namibia and Botswana to compete favourably with the rest of the world in terms of production of high value-added products needed by local and international industries.

Table 5. 46: Close gap in the innovation value chain

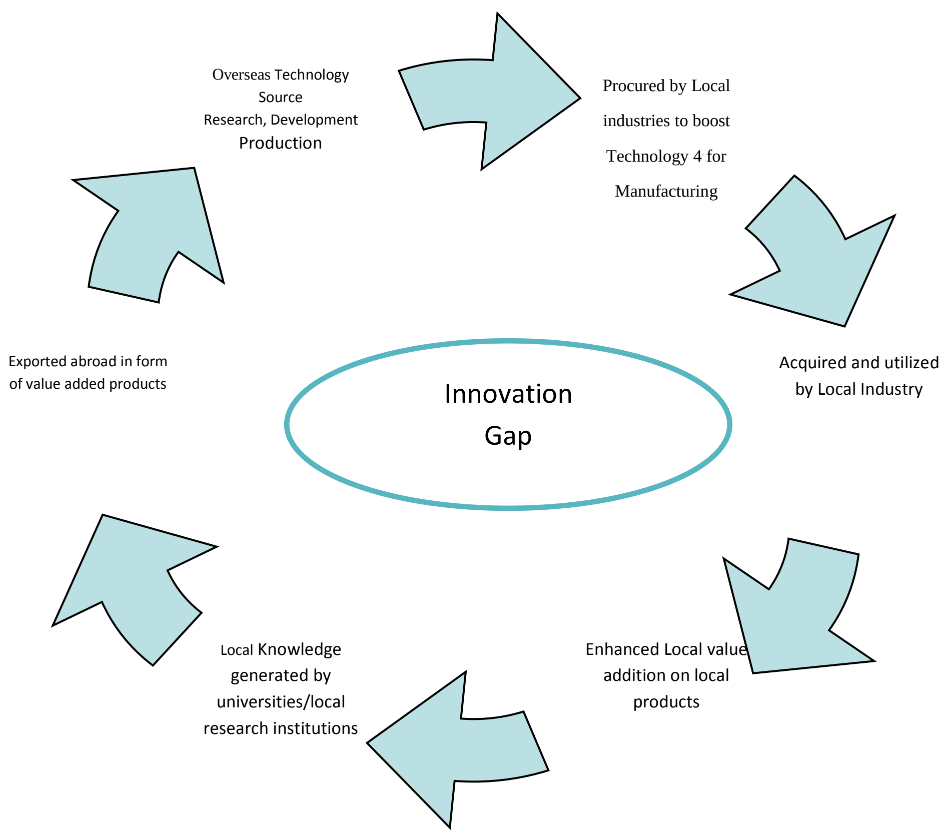
Close gap in the innovation value chain					
		Frequency	Percent	Valid Percent	Cumulative Percent
Close gap in the innovation valve chain	Disagree	2	1.6	1.6	1.6
	Neutral	11	8.9	8.9	10.6
	Agree	34	27.6	27.6	38.2
	Strongly Agree	76	61.8	61.8	100.0
	Total	123	100.0	100.0	

Source: Primary Data

The study further shows that 61.6 % of the respondents strongly agreed and 27.6% and agree that enhanced value addition by local industries on local products through maximization of local knowledge generated from universities/ research institutions to produce products and services will lead to high growth of the economy, increase employment and promote competitiveness.

The Innovation Gap (Missing link) in the Innovation value chain

Figure 5. 3: Innovation Gap



Source: Author’s own compilation

Figure 5.3 above presents an illustration that there is a missing link in the innovation value chain. This is resulting from low local value addition or transformation of basic research outputs into value added products that can be procured by both local and overseas industries. The ideal situation will be when output from local research is further enhanced through value addition and there is production of technology that can be exported to and utilised by overseas markets to overturn the current pattern where universities and local industries export raw products and import technologies for manufacturing from abroad.

5.13.6 Establish Innovation networks

According to Manzini (2015) the strength of an innovation system is dependent on the quality, quantity and efficiency of the flow of key information within the key elements that make up the NSI. Innovation Networks throigh partnerships, cooperation projects and joint ventures are critical to the development of a well connected system that capitalise on the estbalished knowlegde flows within the NSI to increase innovation intensity. The study asked the repondents to give their veiws on the indicator „ Establish Innovation Networks“ whether they agree or disagree with the statement. Table 5.47 presents the veiws of the respondent.

Table 5. 47: Respondents' ranking on the Establishment on innovation networks

Establish innovation networks					
		Frequency	Percent	Valid Percent	Cumulative Percent
Establish innovation networks	Disagree	3	2.4	2.4	2.4
	Neutral	13	10.6	10.6	13.0
	Agree	34	27.6	27.6	40.7
	Strongly Agree	73	59.3	59.3	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Innovation networks are very important for sustaining and maintaining regional and international joint ventures and strategic alliances for R&D for enhanced longtime survival. Therefore, Namibia and Botswana have made strides in this regard by being active members of global networks like the Global Research Governing Council and RINEA where its agencies NCRST and BITRI benefited through innovation funding. Results in Table 5.47 above present the rankings of the respondents on the statement “Establish innovation network”. 59.3% strongly agree and 27.6% agree that establishment of innovation networks is beneficial to innovation coordinating bodies in drawing experiences and best practices from collaborating partners.

5.13.7 Encourage the participation of SMEs in the innovation value chain

Namibia’s industrial and SME policies and the growth at home strategy have explicit strategies on value addition which could be beneficial to SMEs. The Ministry of Industrialisation, Trade and SME Development in Namibia also administers the Infancy Industry Protection Policy which provides an opportunity to SMEs intending to advance to the manufacturing stage. The Development Bank of Namibia through its SME portfolio provides financial assistance in the form of loans/grants which are non-collateral based, to SMEs and informal traders (Ministry of Industrailization Trade & SME Development, 2012a). In addition, local commercial banks' operations in Namibia like the First National Bank of Namibia (FNB), Bank Windhoek, Standard Bank Namibia, the Agricultural Bank of Namibia, and Nedbank all have facilities that provide to financial support to SMEs (Ministry of Industralization, Trade & SME Development, 2012b).

The Botswana government also values the contribution of SMEs and informal markets to economic growth and employment creation, hence, the reason credit schemes targeted at supporting SMEs are established at various financial and developmental institutions like the Center for Entrepreneurial Development Agency (CEDA); the National Development Bank (NDB); the Botswana Development Corporation (BDC) and other commercial banks operating in Namibia.

However, with all these opportunities available to SMEs in Namibia, access to these funds remains a challenge as the majority of the SMEs and informal traders lack the knowledge of developing bankable business plans. Hence, the ministry of Industrialisation, Trade and SME development in partnership with the Namibia Chambers of Commerce and Industry have introduced a mentorship programme that is aimed at equipping SMEs and with skills of developing business plans (Ministry of Industrialisation, Trade & SME Development, 2016).

Table 5. 48: Encourage the participation of SMEs in the innovation value chain

Encourage the participation of SMEs in the innovation value chain					
		Frequency	Percent	Valid Percent	Cumulative Percent
Encourage participation of SMEs	Disagree	1	.8	.8	.8
	Neutral	7	5.7	5.7	6.5
	Agree	30	24.4	24.4	30.9
	Strongly Agree	85	69.1	69.1	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Small and Medium Enterprises play a major role in enhancing the innovation value chain as most innovators start as SMEs and later grow to become manufacturers who boost the economic development of a country. The Table 5.48 above shows that 69.1% of the respondents strongly agree and 24.4% agree that encouraging the participation of SMEs in the innovation value chain is critical to close the gap between the demand pull of local industry on knowledge / innovative ideas generated by innovators and entrepreneurs and passed on to the local universities for research and development to produce value added products and services needed by industry. These results are in agreement with the findings of Warwick (2013)'s study of OECD countries on new initiatives and trends beyond industrial policy that put emphasis on the contribution of SMEs and informal markets as backbones for advancement of the manufacturing sector and achievement of economic growth and competitiveness (Warwick, 2013).

5.13.8 Establish national R&D funding

Countries like Finland, South Africa, the United States of America, and England have advanced research and development infrastructure and systems of innovation because of their dedicated national funding for R&D through established national R&D Funds.

Though both national STI policies and legislations make provisions for such, initiative the realization of this commitment remains a challenge. For example, Namibia through the NRST policy and the research science and technology Act, 2004 (Act 23 of 2004) proposed the creation of a National Research Science and Technology fund but till today, this fund is not yet operational (Government of the Republic of Namibia, 2004). Furthermore, the proposed funding of 0.3 percent of GDP as indicated in the NDP4 was not allocated to the appropriate agency which is the NCRST. Botswana, on the other hand, has managed the national research science and technology fund as well as the innovation fund through the Botswana National Research and Innovation Coordinating Committee (Ministry of Infrastructure, Science and Technology, 2011).

Table 5. 49: Establish national R&D funds

Establish national R&D funds					
		Frequency	Percent	Valid Percent	Cumulative Percent
Establish national R&D funds	Neutral	11	8.9	8.9	8.9
	Agree	32	26.0	26.0	35.0
	Strongly Agree	80	65.0	65.0	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Results in Table 5.49 shows the respondents' ranking on the establishment of national R&D funds, to which 65.0% of the respondents strongly agreed and 26% agreed that establishment of national R&D funds would play a major role in increasing the country's research and innovation output. These results confirm the commitments made by both countries in their national STI policies and legal frameworks.

5.13.9 Develop Centers of Excellence for R&D in all key research priorities

The Namibia National Programme on Research Science, Technology, and Innovation (NPRSTI) developed by the NCRST and adopted by Cabinet comprises of fifteen key priority research areas namely: agriculture, fisheries & marine, mining, water, energy, geosciences, indigenous knowledge, social sciences & humanities, logistics, environment & tourism, ICT, Biotechnology, manufacturing technologies and space science (NCRST, 2014). The NCRST is still facing a challenge in coordinating R&D across the approved research priorities due the fragmented structures and budgets. There are few dedicated Centers of Excellence established to address the research challenges in these research thematic areas (NCRST, 2016).

However, Namibia has made positive achievements in addressing the challenge mentioned above by the integrating STI considerations into the Vision 2030, NDPs as well as establishment of organizational agencies like NCRST, BIPA & NSI to strengthen the National System of Innovation. The other institutions established to serve a Centre of Excellence for R&D are the Desert Research Foundation of Namibia (DRFN) (UNESCO Centre of excellence in Desertification), the University of Namibia, Sam Nujoma Marine Coastal Resource & Research Centre (SANUMARC), the Namibia University of Science and Technology 's Business Innovation Institute (NBII) and the National Training Authority (NTA).

According to UNESCO (2013) the GO-SPIN review on Botswana's Science, Technology and Innovation landscape recommends the establishment of centers of excellence in research priorities to address contemporary challenges as identified in the NDP 10 in form hubs such as:

- The Agricultural Hub established as a catalyst for with great potential commercialization of agriculture outputs, diversification of agricultural techniques to mitigate the effects of climate change and ensure food security.
- The Education Hub established to make Botswana a regional centre of excellence that will be geared towards promoting economic diversification and sustainable growth through the provision of quality education, training and research in the key strategic areas as identified in NDP10;
- The Botswana Innovation Hub established as an incubation centre to the purpose of enhancing national competitiveness through technology transfer, mentoring and coaching business start-ups in collaboration between universities and industry in R&D commercialisation and the development of capacity in innovation;
- The Botswana Diamond Hub positioned Botswana has a regional hub for De Beers Marine diamond trading office since it relocated from London. The cutting and polishing facility to enhance value addition to the diamonds;
- The Botswana Transport Hub intends to see Botswana as SADC regional hub for road, rail, air transport;
- The Botswana Health Hub established to facilitate the implementation of the Vison 2016 pillar on the improving service delivery and provide quality service across the health sector by

creating strategic public –private partnership in form of clinical and research centres of excellence enhance to delivery of high-quality health services can contribute to economic.

The realization of progress in addressing the challenges of the identified key priority areas can only be done through the development centers of excellence for R&D in key research priorities (NCRST, 2014). Also other instruments that supports idea as suggested above are the African Union' s Science Technology and Innovation Strategy for Africa 2014-2024(STISA 2014) and the SADC Science, Technology and Innovation Protocol emphasizes the creation of centers of excellence in key research priorities as a means of addressing R&D matters on the national research agenda (SADC, 2008) and (African Union, 2014).

Table 5. 50: Develop centres of excellence for R&D in all key research priorities

Develop centers of excellence for R&D in all key research priorities					
		Frequency	Percent	Valid Percent	Cumulative Percent
Develop centers of excellence for R&D	Disagree	1	.8	.8	.8
	Neutral	11	8.9	8.9	9.8
	Agree	26	21.1	21.1	30.9
	Strongly Agree	85	69.1	69.1	100.0
	Total	123	100.0	100.0	

Source: Primary Data

The results on Table 5.50 above shows that 69.1% of the respondents strongly agree and 21.1 disagree with the statement that developing centers of excellence for R&D in all key research priorities is a viable solution to improving STI policies and strategies. Therefore, it is imperative that centers of excellence be developed in key priority areas identified by both countries to facilitate the strengthening of national systems of innovation for economic development.

5.13.10 Human Capital Development

The governments of Namibia and Botswana are committed to improving their ranking on the world economic competitiveness forum and the global innovation index through interventions aimed at improving their human capital development personnel in STEM that are critical for economic competitiveness. The creation of dedicated S&T institutions in the names of Namibia University of Science & Technology (NUST) for Namibia and the Botswana International University of Science and Technology (BIUST) is one such initiative to facilitate the development of capacity in STEM fields. Secondly, the University of Namibia have introduced new programmes like Medicine to train doctors, Engineering & ICT for all engineering and ICT disciplines, Veterinary Medicine, Dentistry and Architectural sciences.

Table 5. 51: Human Capital Development

Human capital development					
		Frequency	Percent	Valid Percent	Cumulative Percent
Human Capital Development	Strongly Disagree	4	3.3	3.3	3.3
	Neutral	13	10.6	10.6	13.8
	Agree	17	13.8	13.8	27.6
	Strongly Agree	89	72.4	72.4	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Human capital development is core to improving the science, technology and innovation landscape for Namibia and Botswana as they both aspire to attain a knowledge-based society and economic growth. The results from Table 5.51 above show that 72.4 of the respondents strongly agree and 13.8% agree that human capital development is critical to improving science, technology, and innovation strategies.

5.13.11 Strong Political Will

Strong political will in the context of Namibia and Botswana in relation to the role played by government in developing national systems of innovation can be observed in commitments made by both countries in the creation of Ministries responsible for STI policy direction and governance as well as setting up of STI coordinating and implementing agencies like the National Commission on Research Science and Technology (NCRST) for Namibia and the Botswana Institute for Technology, Research and Innovation(BITRI). The national development plans such as the fourth National Development Plan (NDP4) confirms the government's commitment towards increasing R&D expenditure of the country's GDP to at least 0.3% by 2017 (Government of the Namibia, 2012) as well as the 1% of GDP expenditure to be spent on R&D by 2015 a target under the SADC Protocol on Science, Technology and Innovation which Namibia has ratified in 2011 is another way of demonstrating strong political will (SADC, 2008). Botswana on the other hand also (Vision 2016) all emphasise on the countries 'dedication and willingness to support R&D and Innovation by committing at least 0.3 % of GDP expenditure to be spent on R&D by 2017 for Namibia (Government of the Namibia, 2012) and Botswana's eleventh National Development Plan (NDP11).

Table 5. 52: Strong Political will

Strong Political will					
		Frequency	Percent	Valid Percent	Cumulative Percent
Strong Political will	Strongly Disagree	1	.8	.8	.8
	Disagree	2	1.6	1.6	2.4
	Neutral	11	8.9	8.9	11.4
	Agree	26	21.1	21.1	32.5
	Strongly Agree	83	67.5	67.5	100.0
	Total	123	100.0	100.0	

Source: Primary Data

The results from Table 5.52 above shows that 67.5% of the respondents strongly believe that a strong political will is vital in developing a national system of innovation that is economically competitive. Evidence from literature reveals that for both Namibia and Botswana that there exists strong political support towards advancing STI through the establishment of dedicated agencies like NCRST and BITRI tasked with the reasonability of implementation of national STI agendas (Ministry of Higher Education Vocational Training Science & Technology, 1999) and (Ministry of Infrastructure, Science and Technology, 2011) respectively.

5.14 Role of Governments

This section answers research question 9.2: what is the role of governments in promoting University Industry linkages to improve the STI environment?

Furthermore, the section provides responses from the respondents' views on the role of government in promoting University Industry linkages as a means of improving the STI environment using the following initiatives: (1) Establish patent laws to support patent sharing (2) Provide venture capital for startups (3) Provide matching funds channeled through research bodies for joint R&D projects (4) encourage the setting up of R & I centers within universities

The study used a Factor Analysis model to determine the relationship between the roles played by governments in developing NSI against the variables presented in Table 5.53 below:

Table 5.53: Factor Analysis on the Role of GRN in Developing NSI

	Factor			
	GRN role	communality	Cronbach alpha	KMO
Establish patent laws to support patent sharing	0.396	0.396	0.792	0.716
Provide venture capital for start-ups	0.640	0.640		
Provide matching funds channelled through research bodies for joint R&D projects	0.869	0.869		

Encourage the setting up of R & I centres within universities	0.740	0.740		
Provide matching funds and a national support structure for SME development (establishment of research agenda)	0.442	0.442		
Provide tax incentives or soft loans for R &D by enterprise channelled entirely or partially to Universities	0.473	0.473		
Design national regulatory frameworks with regards to ownership of IPR at HEI, industries and individuals				

Source: Primary Data

Table 5.53 above shows the results of factor analysis which indicates that government plays a major role in developing national systems of innovation through influencing the above-mentioned variables in table 5.53. The shown Cronbach alpha value of 0.792 as measure of reliability falls above the acceptable limit (0.6) as lower limit to 0.7 as upper limit (Hair Jr, Black, & Anderson, 2010) and confirms the role of government in establishing patent laws to support patent sharing; provision of venture capital to support start-ups; provision of matching funds that are channelled through research & innovation centers to support joint research projects; encouraging the setting up of research & innovation centers among universities; provision of matching funding to support SME development; provision of tax incentives for enterprises engaged in R&D in partnership with universities and research institutions and develop national regulatory policy frameworks to manage the IPR produced by Higher Education Institutions, Industries and Individual citizens.

5.14.1 Establish patent laws to support patent sharing

Namibia and Botswana are both members of the African Reginal Intellectual Property Organisation (ARIPO) the Wworld Intellectual Property Organisation (WIPO). Both countries have signed and ratified the SADC Industrial Property Protocol in 2012 (Ministry of Industrailization Trade & SME Development, 2012a). At national level, they have developed laws (Industrial Property Act, 2012 (Act 1 of 2012)) and policies (Namibia Industrila Policy and Botswan Industrila Policy) that regulates patents as well as estabilshed instutions to coordinate IPR and manage patents. The table below show the veiws of the respondents on whether establishment of patents laws to support patents sharing will help universties strenghten linkages with industries on co-funded research.

Table 5. 53: Establish patent laws to support patent sharing

Establish patents laws to support patent sharing					
		Frequency	Percent	Valid Percent	Cumulative Percent
Establish patent laws to support patent sharing	Strongly Disagree	3	2.4	2.4	2.4
	Disagree	2	1.6	1.6	4.1
	Neutral	20	16.3	16.3	20.3
	Agree	37	30.1	30.1	50.4
	Strongly Agree	61	49.6	49.6	100.0
	Total	123	100.0	100.0	

Source: Primary Data

Governments plays an oversight function through enacting national intellectual Property laws to support universities in their process of developing patent laws that guides patents sharing with industries on co-funded research and development. The above statement is supported by the results from Table 5.54 above where 46.6 % of the respondents interviewed strongly agreed that if IPR policies are established at university level, they will help ease the sharing of patents generated through collaborative research. This will then lead to strengthened linkages between industry and universities.

5.14.2 Provide venture capital

The provision of venture capital for start-ups in incubation centers at universities/ research centers by industry is one way of forging a strong relationship between universities and industry. Here government's role is to create an enabling environment that promotes the establishment of linkages between universities and industry. The table below shows the respondents views on the indicator "Provide venture capital".

Table 5. 55: Provide venture capital

Provide venture capital for start ups					
		Frequency	Percent	Valid Percent	Cumulative Percent
Provide Venture Capital	Disagree	2	1.6	1.6	1.6
	Neutral	17	13.8	13.8	15.4
	Agree	32	26.0	26.0	41.5

	Strongly Agree	72	58.5	58.5	100.0
	Total	123	100.0	100.0	

Source: Primary Data

The results shown in Table 5.55 above supports the statement as most of the respondents with a combined percentage of 84.5% strongly agreeing and agreeing that the provision of venture capital for startups boosts entrepreneurship and innovation culture.

Although, most respondents strongly agree that venture capital is important for innovation and entrepreneurship, the author observed that venture capital financing or funding for R&D is not easily available in both Namibia and Botswana as the majority of industries operating in the countries are proxies of multinational companies from abroad who are interested only in selling their finished goods. These local industries lack empowerment to partner with government in providing funding to enterprises that could be used to stimulate university-industry collaborations.

5.14.3 Provision of matching funds channelled through research bodies for joint R&D projects.

Governments need to play an active role in establishing an enabling environment through policy interventions that support the provision of matching funds to support joint university and industry collaborative R&D projects to be managed by the designated national research entities.

Lessons from where this practice has been implemented have yielded successful results in the form of a high inflow of capital from industry and global partners to benefit research bodies.

South Africa is one such country leading in the SADC region when it comes to strengthened university and industry collaborative R&D projects with the European Union under the Horizon 2020 and the BRICS's R&D initiatives which could be emulated by both the Namibian and Tswana governments. The experience by the South African government in participating in co-funding Research and Innovation initiatives with programmes like RINEA under Horizon 2020 has led to increased foreign direct investment in R&D and research and development output for entities like NRF has increased. Therefore, the two governments of Namibia and Botswana need to commit resources dedicated to co-funding. These resources should be channeled through their research entities like NCRST and BITRI of promote collaborative R&D project participation in initiatives like RINEA of the Horizon 2020. This would help to increase their R&D capital and capacitate their research bodies.

Table 5.56: Matching funds channelled through research bodies

Provide matching funds channeled through research bodies for joint R&D projects					
		Frequency	Percent	Valid Percent	Cumulative Percent
Matching funds for R&D	Strongly Disagree	1	.8	.8	.8
	Disagree	3	2.4	2.4	3.3
	Neutral	18	14.6	14.6	17.9
	Agree	33	26.8	26.8	44.7
	Strongly Agree	68	55.3	55.3	100.0

	Total	123	100.0	100.0	

Source: Primary Data

Table 5.56 above shows the results on how the respondents reacted to the statement whether providing co-funding channeled through research bodies would promote University-Industry linkages and improve the entire STI environment. It can be confirmed from the results above that the provision of co-funding to collaborative R&D projects by governments builds a strong relationship between universities and industry.

5.14.4 Encourage the Setting up of the setting up of R&I Centre within Universities

University-Industry linkages are strengthened if universities are encouraged to set up research and innovation centres that would transform industry research and innovation challenges into products, processes and services that would make industries remain competitive.

Table 5.57: Encourage the setting up of R&I Centre within universities

Encourage the setting up of R &I centers within universities					
		Frequency	Percent	Valid Percent	Cumulative Percent
Encourage the	Disagree	5	4.1	4.1	4.1

setting up of R&I Centers	Neutral	14	11.4	11.4	15.4
	Agree	28	22.8	22.8	38.2
	Strongly Agree	76	61.8	61.8	100.0
	Total	123	100.0	100.0	

Source: Primary Data

The statement above is supported by the results presented in Table 5.57 above, where a combined majority with a percentage of 84.6% strongly agreed that encouraging the setting up of R&I centers within universities helps industries to find solutions to problems that require research.

5.15 Summary of Chapter Five

This section presents the summary finding of study as indicated in the following tables below:

Table 5.58: Summary findings

Thematic Area	**Measure**	**Findings**
Characteristic of an effective NSI	Effectiveness of evidence based STI policies	There is a need to develop evidence based STI policies supported by dedicated funding framework for R&D.
STI Policy framework and strategy	Existence of coherent policies	Coherent STI policies needs to developed through harmonising existing policies for purpose of entrenching an innovation culture among its citizens by removing barriers that hinders the promotion of innovation and entrepreneurship.
STI Policy framework and strategy	Availability of demand factors (shelter, water, sanitation, health care & education system); National endowments (rich mineral resources, primary, tertiary industries), contribution of R&D to GDP, levels of innovation development and technology transfer adaptation capacity.	Namibia and Botswana need to take advantage of their natural endowment through adding value to its local rich mineral resources by processing it locally and export finished products. For Namibia, there is a good initiative through its Industrial Policy of 2012 which allows for value addition under the growth at home strategy. Botswana on the other hand has made progress in the local processing of its diamonds.

Source: Author's own compilation

Table 5.59: Summary findings (cont'd)

Thematic Area	**Measure**	**Findings**
Challenges in Implementing STI polices and strategies	Availability of support infrastructure, existence of dedicated ministries of STI,	Infrastructure to support the implementation of STI policies and strategies in both countries was found to be weak. STI was seen has not embedded in the national visions of both countries trade for example. Hence this leads to STI considered as a periphery sector making its budget channeled through either ministry of education and planning.
Solutions to improve Namibia and Botswana STI policies and strategies	Degree of policy harmonization, focus on emerging forms of innovations; strengthen policy coordination, coherence and political leadership	STI policies needs to be harmonized to avoid duplications e.g. one looks at the Namibian Industrial Policy and National Research Science and Technology Policy of 1999 there seem to be a mandate clash with regard who sector should champion innovation in Namibia. The coordination of STI bodies in both countries needs to be strengthened i.e. NCRST and BITRI mandates to be visited to position them clearly as implementing agencies of the national research agendas for both countries.

Source: Author's own compilation

Table 5.60: Summary findings (cont'd)

Thematic Area	Measure	Findings
Role of Governments	Strength of Foreign policy (FDI) in leveraging funding for R&D Level of implementation of national research & innovation agendas	Governments should create enabling environment that promote the creation of an innovation culture through maintaining a strong political leadership and create agencies of change and sustain them financially.
University Industry Linkages	Strength of University-Industry Linkages	Universities needs to forge strong linkages with industries to ensure industry R&D priorities matches with universities. Universities should be encouraged to develop institutional research policies in collaboration with industry

Source: Author's own compilation

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter presents the conclusions, policy recommendations with specific reference to major lessons drawn from the study and best practices on what the NSI for Namibia and Botswana should do to improve their Economic Development & Competitiveness. The researcher also suggests areas for further research. The chapter is divided into three sections: Section 6.2 presents the conclusions and policy recommendations. Areas for further research are presented in section 6.3.

The main aim of this study was to compare the performance of the two National Systems of Innovation for Namibia and Botswana and how they influence national economic development & competitiveness. Furthermore, the study managed to establish the following key thematic areas, i.e. characteristics of an effective national system of innovation; Namibia-Botswana Science, Technology and Innovation Policy Framework and Strategies; Science, Technology and Innovation Resources linked to Wealth Creation. It also established the Challenges faced by the two countries in implanting STI Policies & Strategies; Solutions needed to improve STI Policies and Strategies for Namibia and Botswana; the natural endowment for Namibia and Botswana; the role of Governments in improving economic competitiveness. The research also established, University-Industry linkages drawn from the research questions, which were presented as a source of evidence needed to build an effective and efficient National System of Innovation, which is economically viable and helps build a nation's competitive advantage.

6.1.1. Research Questions

The study used the following research questions as listed below to generate thematic research areas to further probe and confirm the assumptions from the empirical literature with the findings of the study, based on the responses given by the sampled population.

6.1.1.1 What are the key characteristics of an effective National System of Innovation?

6.1.1.2. What are the characteristics of Namibia and Botswana`s innovation policies?

6.1.1.3. To what extent have Namibia and Botswana implemented their innovation policies?

6.1.1.4. To what extent has science, technology, and innovation (STI) contributed to Namibia and Botswana`s material base and wealth?

6.1.1.5. What challenges have been encountered by Namibia and Botswana in implementing their science, technology, and innovation strategies?

6.1.1.6. How can Namibia and Botswana improve their science, technology, and innovation strategies?

6.2 Summary of Literature Review

The study found that the existence of evidence-based science, technology and innovation policies which outline well-defined university-industry linkages and funding framework for human & institutional R&D and innovation infrastructure supported by an education system that is responsive to industry demand and technology push leads to an effective national system of innovation that is economically competitive.

For Namibia, a country that aspires to become an industrialised, prosperous, and economically competitive by 2030, there is a need to consider the contribution of both the public and private sectors in an efficient and effective delivery of social and economic services to its citizens. This would require the production of skilled STI manpower needed to accelerate the implementation of innovation related polices to produce economically variable knowledge that can be transformed into STI wealth creation. It is against this background that the Namibian government through the Office of the Prime Minister has benchmarked with international norms and best practices from countries like Finland and Denmark in building a government-wide Public Service Innovation Policy. This policy aims at introducing new applications to inform practices, products, services, and organisational changes that create new value through improved service delivery.

On the overall STI landscape, the study found out that Namibia does possess good innovation related polices but the challenge lies in the implementation phase. This is due to there being a huge lack of social policy cohesion and a long policy gestation period. A good example is the period taken from the development of the first National Research Science and Technology Policy (1999) to the enactment of the Research Science and Technology Act, 2004. The Regulations were only developed in 2011 and yet the operationalization of the NCRST was only realised in 2013.

Secondly, on social cohesion and continuity, it has been a trend in Namibia that each minster appointed to head the STI portfolio always wants to start a new STI policy. For example, the review of the Research Science and Technology Policy of 1999 was started by the NCRST in 2015 but when the new Ministry of Higher Education Training and Innovation was created in 2015, the new Minister initiated a new review of Namibia's STI landscape with the assistance of UNECSO. This review recommended the development of a new STI policy framework to serve as an umbrella policy to all. This presented a parallel process to the one already initiated by the NCRST. This posed coordination challenges, resulting in much time spent on developing policies and less time for implementation as political office bearers stay in office for a five-year period.

The Botswana Government on the other hand has introduced a presidential innovation award which is annually awarded by the President of the Republic of Botswana to outstanding achievers in championing innovation in the country. Furthermore, the last review of Botswana's NSI revealed that STI is a critical sector in guiding economic competitiveness. This is evident from the way Botswana managed to make use of its established hubs (innovation, education, diamonds, health, transport and agriculture) whose output helps to improve its ranking on the World Economic Competitiveness & Global Innovation Index and other international rankings (UNESCO, 2013).

6.3 Summary of Research Methodology

The methodology used in this study was a mixed research method comprising of two phases, namely, quantitative and qualitative research approaches were used to conduct a comparative analysis of Namibia and Botswana's National Systems of Innovation for national economic competitiveness.

Phase one of the study was a quantitative research approach where quantitative data was gathered using a survey questionnaire method on the sample selected from the main research population. The results from this method were analysed using SPSS to determine the statistical inferences needed by the study to make conclusion on the quantitative data collected from the key informants, purposefully selected from the quantitative phase (Creswell, 2014). The second phase of the research design was looking at qualitative data gathering by means of semi structured interviews done on key informants selected from phase one of the study who were sampled and interviewed to further explain the responses from phase one of the study (Creswell, 2014; Mabhiza, 2016).

This approach was used with an understanding that quantitative and qualitative methods employed during triangulation, complemented each other in providing enriched or detailed analysis that would not be available if only one method was used in the study. Thus, triangulation has been found to be more useful in providing comprehensive data and leads to an increased validity and reliability of results (Bekhet & Zauszniewski, 2012).

6.4 Summary of key findings from Quantitative Research Phase of the study

From the above research questions, eight thematic areas as listed below were generated.

6.4.1 Characteristics of an effective National System of Innovation

Literature reviewed by the author showed that the effectiveness of an NSI is dependent on how strong linkages are created among policy-making bodies, universities, public research institutes, financial institutions, private enterprises and technology and innovation support agencies (Mytelka, 2016). Shorter turnaround time between policy formulation of STI evidence-based policies and its implementation is another attribute identified from literature as a characteristic for an effective and efficiency NSI (UNESCO, 2016 and UNESCO, 2013).

Respondents on the survey revealed that 7.3% were undeceided whether the existence of evidence based STI policies can be a key characteristic of an effective NSI, 2.4 % disagreed whilst 20.3% of the respondents agreed and 69.9% strongly agreed that evidence based STI policies is a charactersitic of an effective NSI. Whilst in Table 5.9 of the study , 1.6 % of the respondents disagreed and 13.8% were undecided on whether having a funding framework for R&D is characteristic of an effective NSI. However, 13.8% of the respondents agrees and 70.7% strongly agreeing that the existence of a funding framework for R&D is a characteristic of an effective NSI.

The other indicator identified by the study as an engine for an effective NSI is a well defined University –Industry Linkage where 0.8% of the respondents disagreed and 4.9% were undecided, 20.3% agreeing and 65.9% strongly agreeing that having a well defined university-industry linkage leads to an effective NSI.

On the question of whether the education systems adopted by both countries is are likely to produce the required hunan resources equipped with requisite skills and knowledge to innovate and produce goods and services to meet the demands of industry. The findings reveal that 65.9 % strong agree that having a good education system will lead to the development of a critical mass of skilled manpower needed by industry.

Table 5. 13 reveals that 65.9% of the particiapants in the study strongly agree that have a large number of registered patents is a measure of an effectieve NSI, whilst 20.3% of the respondents only agreeing. The above responses resonants well with the literature revealed. The rest showed that 10.6% were undecided and 2.4 or 0.8% disagreed.

Findings from Table 5.14 revealed that 64.2% of the respondents strongly agreed and 25.2% agreed that application of a triple helix model of innovation where unviseristies, industry and government are interconnected, interact and suport each to pormote innovation as a measure for an effectieve NSI. These results are supported by the suggestions of Leydesdorff (2005) on how to change knowledge based innovation systems using the interconnected dynamism that exist between the three players industries work closely with universities in internalizing its R&D funstions by allowing universities to run its spin off companies and R&D (Etzkowitz, 2008) whilst governments creates enabling environments through commiting investiments in industrial policies and STI polcies as well as provision of tax incentives to industries. knowledge generated from univeristies supports government to make informed decisions backed by evidence generated through research from (Teixeira, 2013; Etzkowitz & Leydesdorff, 2000 and Aubert, 2004).

As posited by Lundvall et al, (2009) Human resources is core to the development of an effective NSI. Results from Table 5.15 shows that 68.3% of the respondents strongly agreed whilst 22.0% agreed that critical mass of skilled manpower in STI is critical for developing an effective NSI that is economically competitive.

To overcome the challenge, the governments of Namibia and Botswana that committed themselves to invest over 23% of the national budgets allocation to the education, science technology and innovation sectors (Government of the Republic od Namibia, 2012; Ministry of Finance & Develoment Planning, 2007). Secondly, the governments have vowed to adhere to the provisions of the SADC Protocol on Science, Technology and Innovation compiling members states to spend 1% of their GDP on R&D (SADC, 2008) and the African Union declaration to set aside 1% of GDP to be spend on R&D by members states by 2020 (African Union, 2014).

On the question of measuriing the contribution of SMEs towards developing an effectieve NSI that is economically competitive results from Table 5.16 shows the majority of respondents strongly agreed with a percentage of 65% and 23.6 % agreed whilst 8.1% were nuetral with 3.3% disagreed.The study concluded that high participation of SMEs in growth economy leads to development of a strong manfcaturing sector that should supply these SMEs with tools, materials and equipment to enable them to innovate.

6.4.2 Namibia-Botswana Science Technology and Innovation Policy (STI) Framework and Strategies

As indicated in the UNESCO report on Namibia review of its TVET, Higher Education and innovation policy (UNESCO, 2016) and the Botswana STI policy review (CSIR, 2005) done by the CSIR the STI policy frameworks and strategies are characterized with gaps and barriers hindering advancement of innovation and entrepreneurship. Developing polices that are Coherent is identified as one of the mechanisms of addressing challenges encountered by Namibia and Botswana in implementing its STI polices and strategies. Results from Table 5. 18 in the study shows that the majority of respondents constituting 46.3% strongly agree followed by 34.1 % who agrees that existence of coherent STI policies are critical for Namibia and Botswana to address challenges hindering advancement of research and innovation & economic growth for competitiveness.

The second machinery is for both countries to put in place mechanisms that are aimed at removing barriers preventing the smooth introduction and application of innovation and entrepreneurship, engagement of enterprises in skill formation and innovation development, having enhanced institutional linkages/ partnerships with companies as well as having dedicated funding systems to support R&D and Innovation within their STI ecosystem. Respondents were asked whether removing barriers on innovation and entrepreneurship development, engagement of enterprises in skill formation and innovation development, having enhanced institutional linkages/ partnerships with companies, having strong university industry linkages as well as having dedicated funding systems to support R&D and Innovation would create opportunities for innovators and entrepreneurs to innovate and contribute to economic growth and wealth creation.

Results from Table 5. 19 indicate that the majority, 39.8% of the respondents strongly agree that removing barriers on innovation and entrepreneurship contributes to economic growth and wealth creation. Table 5.20 & 5.21 show that 30.1% of the respondents strongly agree that engaging enterprises in skills formation and innovation whilst 35% of the respondents strongly agree that having enhanced institutional linkages with companies or communities reduce the risk of excluding the needs of companies or communities during STI development and implementation.

Strong university industry linkages as well as having a dedicated funding system to support R&D and Innovation are also some of the attributes Namibia and Botswana needs to integrate into their STI policies. Results from Table 5.22 of study indicates that 69.9% representing majority of the respondents strongly agreed and agreed that having a strong university industry linkage leads to an effective NSI as industry will finance R&D to improve its productivity and universities produces knowledge needed by industry to innovate. Table 5.23 shows that 37.4% of the respondents strongly agrees & 33.3% agrees that a dedicated funding system to support R&D and Innovation is critical in achieving the commitments of realizing the 1% of GDP expenditure spend on R&D made by Namibia and Botswana at continental (AU level), regional (SADC protocol on STI) and nationally in the NDP 10 (Botswana) and NDP5 (Namibia: achieve 1% expenditure of GDP by 2020).

The study concludes that having coherent policies, removing barriers on innovation and entrepreneurship development, engagement of enterprises in skill formation and innovation development, having enhanced institutional linkages/ partnerships with companies, having strong university industry linkages as well as having dedicated funding systems to support R&D and Innovation as key indicators for developing and implementing effective STI policies and strategies.

6.4.3 Science, Technology, and Innovation Resources linked to Wealth Creation

The study classified the following the indicators being contribution from % of GDP expenditure on R&D, % of innovation, research & development to the overall economy, Number of technology transfer and adaptation projects, ability to build scientific and technical capacity and level of participation of scientists in the diaspora as key resources for revenue generation linked to wealth creating, economic growth and sustainable development of Namibia and Botswana's Science, Technology and Innovation System.

Results from Table 5. 32 in the study shows that 48% of the respondents strongly agreed and 35.8% agreed that increased GERD leads to high ranking on the World Economic Forum and economic competitiveness of countries. The findings are support by literature revealed where Botswana with GERD value of 0.54 % (CSIR, 2005) is ranked higher than Namibia with a GERD of 0.35% (NCRST, 2017). The rest were undecided or strongly disagreed.

On the question of the contribution of innovation, research & development output as a resource linked to competitiveness 47.2% of the respondents strongly agreed and 34.1% agreed that increased innovation research & development output translates into increased manufacturing sector with capability of production of goods and services that dominates the market share, hence attaining competitive advantage over competitors.

The ability to adapt the technology transferred and leverage on long time networks created between consortiums from industrialised nations and local industries/institutions in Namibia and Botswana has a potential of increasing their economic competitiveness and increase the Global Innovation Index (Dutta et al , 2017). The results from Table 5.33 in the study confirms that above with 47.2% of the respondents strongly agreed, 26% agreed, 21.1% were neutral, 4.9% disagreed and 0.8 % strongly disagreed.

Findings under Table 5.32 reveals that 47.2% of the respondents strongly agreed that capacity building in STEM translates into a critical mass of skilled manpower with capability to innovate and become competitive. This is in agreement with findings the studies done by UNESCO in Namibia TVET, Higher Education and Innovation Policy review (UNESCO, 2016) and the mapping of research and innovation for Botwana (UNESCO, 2013) capacity in STEM was low which needs to improved if Namibia and Botswana are to comparable with countries like Sungapore and Finland.

Among the participants to the interveiws in the study, results from Table 5.42 shows that 44.7% of the respondents strongly agreed that scientists in the disapora could a meaningful contribution towards economic competiteness if the governments of Namibia and Botswana integrate and mainstream contribution and advise from diaspora into their STI policy formulation. Furthermore, 31.7 % agreed and 19.5% were neutral, 2.4% disagreed and 1.6% strongly disagreed. The conclusion is that disapora can serve as key resources to assist their local peers in developing evidence based STI policies for economic competitiveness.

6.4.4 Challenges in Implementing STI Policies and Strategies.

The study has identified the following challenges hampering the successful implementation of STI policies in Namibia and Botswana being lack of adequate supportive R&D infrastructure, STI not embedded into national visions of the country, STI not seen as a tool for economic growth and development, STI budgets still channelled through ministries of education and planning and not having centralized STI budgets. The results from Table 5.37 in the study indicates 58.5% strongly agrees that there is lack of adequate R&D infrastructure, 29.3% agreeing with the rest were either strongly disagreeing, disagreeing or undecided.

Table 5.38 shows 50.4% of the respondents strongly agree that STI is not embedded in the national visions of both Namibia (*A prosperous and industrialised Namibia, developed by her human resources, enjoying peace, harmony and political stability by 2030*) and Botswana (Prosperity for all by 2036). Looking at both visions it is clear that STI is not embedded in the visions hence, the respondents' opinions are true. In case of Namibia the accelerated implementation plan for Vision 2030 which is the Harambee Prosperity Plan does not mention science and technology in all its pillars (Government of the Republic of Namibia, 2016a).

The results from Table 5.39 shows 50.4% and 31.1% of the respondents strongly agree and agree that STI is not seen as a tool for economic growth and development. These results are supported by the classification of the STI portfolio in both countries as a social sector but not an economic sector like in countries such as Rwanda, South Africa, Finland and Malaysia where STI portfolio is classified as an economic sector.

Namibia and Botswana were over the years not having dedicated ministries of science technology and innovation forcing their STI budgets to be channelled through ministries of education and planning where the portfolio had been attached. This has always caused skewed funding as STI has to compete with demands of basic education and planning for funding. Even after the creation of Ministries responsible for Higher Education, Science, Technology and Innovation in both countries, still STI has to compete with vocational and higher education for funding.

Results from Table 5.40 shows of the respondents 46.3% strongly agreeing and 32.5% agreeing that channelling of STI budgets through ministries of education and planning by Namibia and Botswana over the past years have resulted in overfunding of STI making the sector to effectively implement their STI policies. Furthermore, financing of STI activities in both countries as been fragmented due to the fact that allocation to STI activities is scattered over various ministries calling for a need of a centralised STI budget.

Table 5. 41 shows that 51.2% and 30.9% of the respondents strongly agree and agree that having a centralised budget for STI will ensure a well-coordinated and governance mechanism spearheads the realization of set targets in national research agendas. The study concludes that Namibia and Botswana need to strengthen their STI coordinating agencies (NCRST and BITRI) to overcome challenges in implementing STI policies and strategies and ensure coordination and structural governance.

6.4.5 Solutions to Improve STI Policies and Strategies.

The study concludes by suggesting the following as solutions Namibia and Botswana need adopt in order to strengthen the implementation of their STI policies and strategies: Table 5. 42 shows that 64.2% of the respondents strongly agree, 25.2% agree that Namibia and Botswana need to focus on emerging forms of innovation if they have to remain competitive. The results from Table 49 indicates a need to devise mechanisms of connecting users directly with knowledge cresting firms as 68.3% of the respondents which majority strongly agree.

As for Table 5. 44 the majority of the respondents constituting 67.5% strongly agree and 22 8% agree that Namibia and Botswana need to ensure their STI policies are harmonized to avoid duplication (e.g. harmonizing the current STI policies with the industrialization policies).

Provision of incentives to encourage researchers and scientists to innovate and discover new knowledge was supported by 65.9% respondents who strongly agree under Table 5. 45 in the study. Result from Table 5. 46 in the study show that 61.8% and 27.6% of the respondents strongly agree and agree respectively that closing the gap within the innovation value chain where local knowledge generated by universities/ local research institutions is transformed in commercial viable products can be exported in exchange of imported technologies to be used for manufacturing by local industry/university spin offs leads local industries/universities/ local research institutions with a capabilities of exporting valued added products to overseas markets and remain competitive.

Also, to encourage the establishment of innovation networks to sustain and maintain long-term strategic alliances and joint ventures, 59.3% strong agreed, 27.6% agreed the rest were either undecided (10.6%), disagreeing (2.4%) as per results under Table 5. 47. The other solution is having a strong participation of SME in the innovation value chain where 69.1% of the respondents strongly agreed and 24.4% agreed whilst 5.7% were neutral and 0.8 % disagreed. Encourage the establishment of national R&D funds to advance research and development through equipping and capacitating R&D infrastructure, 65.0% of the respondent strongly agreed and 26.0% disagreed whilst 8.9% were undecided. The Namibia National Programme on Research Science Technology and Innovation and Botswana Research Science Technology and Innovation plan have each set research priorities (CSIR, 2005; NCRST, 2014). The realization of these key research priority areas can be achieved if the countries are encouraged to develop of centres of excellence for R&D in all key research priority areas.

The results from Table 5.50 shows 69.1% of the respondents strongly agreed and 21.1% agreed with 8.9% remained neutral and 0.8% disagreed. Development of human capital to improve the STI landscape, 72.4% of the respondents and 13.8% under Table 5.51 in the study strongly agreed and agreed. Findings and literature revealed there is a strong political will in both Namibia and Botswana towards the advancement of STI through the establishment of dedicated coordinating and agencies such as NCRST and BITRI. Results from Table 5.5859confirms this by showing that the majority representation of 67.5% of respondents who strongly agreed and 21.1% agreed.

6.4.6 Natural Endowments for Namibia and Botswana

Namibia and Botswana are capable of implementing their innovation polices to stimulate national economic competitiveness through the use of the selected indicators for natural endowments. The respondents were asked about their views on best can these endowments can be used to stimulate national economic competitiveness: on the availability of shelter, water, sanitation, health care and education system responsive to industry demand, 44.7 % of the respondents agreed strongly and 30.9% agreed, 17.1% neutral, 5.7% disagreed and 1.6% strongly disagreed.

Table 5. 26 shows results of respondents on the contribution of Namibia and Botswana' rich mineral resources influence the material base, wealth creation and national economic competitiveness. From the above, it was deduced that 39% of the respondents strongly agreed and 38.2% agreed whilst 19.5% were undecided and 1.6% disagreed.

The findings on the performance of Tertiary Industries are presented as follows: 42.3% of the respondents strongly agreed and 34.1% agreed that export of processed meat and fisheries products as well as textiles and services as major contributors towards wealth creation. The other indicator the study considered was the performance of primary industries with a particular focus on mining and energy production.

The results from Table 5. 28 shows 30.9% of the respondents strongly agreed, 39.8% agreed and the rest were undecided and strongly disagreed. Therefore, the study concluded that primary industries such as agricultural (livestock and crop farming), mining and quarrying (diamond, copper, gold, uranium and quarry), fisheries and marine resources contributes towards wealth creation and economic growth for Namibia and Botswana.

Namibia and Botswana have adopted the principle of universal primary education under the UNESCO decade on education which learners to attend school free of charge (Angula, 1990). However, Botswana has managed to provide free education up to university level whilst Namibia only introduced free education at secondary level in 2016. Vocational Education and Training (TVET) is priority in both countries with the governments committing to fully subsidise TVET as it was found to be a great contributor economic growth and competitiveness. The results from Table 5.29 in the study shows 32.5% of the respondents strongly agreed, 35% agreed that a high-quality education and training system will produce high calibre skilled knowledge workers that contributes to economic and social development of its citizens.

On the question whether Foreign Policies triggers Foreign Direct Investments (FDI), the literature in the study found a positive relationship between Foreign Policies that have mainstreamed STI and the FDI generated. Lessons were learnt from countries like South Africa, Kenya and Finland who's Foreign Policies have a component of STI have managed to attract FDI through bilateral and multilateral engagements (OECD, 2005b). Results from Table 5.30 shows 38.2% strongly agreed and 32.5% agreed that there exists a relationship between Foreign

Policies with STI mainstreamed and attraction of FDI targeting research and development programmes and activities.

6.4.7 Role of Governments

Governments plays an oversight role in promoting university industry linkages by creating an enabling environment through establishing legislations that support patent sharing between universities and industries, provision of venture capital to start-up companies or spin offs developed within the innovation value chain, provision matching funds to co-finance joint R&D projects between universities and industries as well as encouraging the setting of R&D and Innovation Centres at universities to transform research and innovation outputs into products, processes and services.

Results from Table 5. 54 shows that 46.6% of the respondents strongly agrees that having patent laws at universities will guide and set modalities of sharing patents generated through collaborative research among universities, industries and private sector. Furthermore, 30.1% of the respondents also agreed with the above. Only 16.3% were undecided with 1.6% disagreeing and 2.4% strongly disagreeing.

Most research or innovation outputs developed by researchers/ innovators at universities fail to kick off because they lack of venture capital. This is role of governments to create such enabling environment through policy interventions that promote public private partnerships which results in forging strong linkages between universities and industries and advocates for the provision of venture capital to finance start-ups or spin off companies resulting from the university industry linkages. Table 5.54 in the study shows that the majority of respondents with a combined percentage of 84.5% strongly agree and agree that venture capital for start-up/spin off is provided to universities by industries it will boost the entrepreneurship and innovation culture among university researchers and innovators. The rest of the respondents either strongly disagreed, disagreed or were neutral.

6.4.8 University-Industry Linkages

Creating an enabling environment through policy interventions that supports national research and innovation funding bodies to provide matching funds for co-financing of collaborative joint R&D projects with global partners abroad, industries nationally and universities is a responsibility of government (Geuna.A, Salter, & Steinmueller, 2003). The study recognised the good model South Africa is currently practising through its R&D funding agency the National Research Foundation (NRF) where joint collaborative R&D projects with the European Union under the Horizon 2020 are co-financed through match funding or co-location (Glrobbelaar, Tijssen, & Dijlsterhuis, 2017).

Table 5.56 shows the results of the respondents on the provision of matching funds to co-finance joint R&D projects as follows: 55.3% strongly agreeing, 26.8% agreeing, 14.6% undecided, 2.4% disagreeing and 0.8 % strongly disagreeing.

University industry linkages is strengthened if universities and industry are encouraged to set up research and innovation centres within campuses that will be capable of transforming the research and innovation outputs into products, processes and services required by industry to growth the market share and remain competitive (Etzkowitz, 2008). The results presented in

Table 5.57 in the study shows that 61.8% of the respondents strongly agree, 22.8% just agree that encouraging that setting up of research and innovation centers within universities helps industries to find solutions to their challenges through research and innovation. The rest were either disagreeing or not sure.

6.5 Summary of key findings from the Qualitative Research Phase

This section provides a summary of the key findings based on the research themes generated from the main research questions used in study.

6.5.1 Characteristics of an effective National System of Innovation

The respondents for the qualitative study, unanimously agreed that the existence of evidence-based science, technology, and innovation policies and well-defined industry-university linkages with strong R&D infrastructure manned by skilled STI personnel are key tools for countries to remain economically competitive.

6.5.2 Namibia-Botswana Science Technology and Innovation Policy (STI) Framework and Strategies.

The study found the need to address the problem hindering the development of coherent STI policies for Namibia and Botswana by avoiding the borrowing syndrome policy, but rather embarking on proper in-house environmental scanning to remove barriers to innovation and entrepreneurship. This could be done through the engagement of enterprises in skills formation and innovation development; ensuring the existence of enhanced institutional linkages/partnerships with companies & communities. Also, through forging strong university-industry linkages and having a dedicated funding system to support R&D and innovation.

6.5.3 Science, Technology and Innovation Resources linked to Wealth Creation

The study found that the following indicators: increasing percentage of GDP expenditure on R&D will lead to the leveraging of benefits of the fourth industrial revolution which are driven characterized by the application of artificial intelligence mechanization of robotics that if Namibia and Botswana commits less resources in the development of research, science, technology and innovation might face a risk where its human resources compete with robots; increased percentage of innovation, research and development will require both countries to continuously impart skills and knowledge to innovate even with less funding and number of technology transfer and projects adaptation. Furthermore, increased capacity building of scientific, technical and vocational personnel with capabilities to innovate and produce products and services needed by the global market, and active participation of scientists in the diaspora are some of the STI resources linked to the contribution to wealth creation and the economic competitiveness of Namibia and Botswana.

6.5.4 Challenges in Implementing STI Policies and Strategies.

The study identified a long policy gestation period (policy adoption to implementation); lack of adequate supportive infrastructure; science, technology and innovation not embedded into national visions of the country; Science, technology and innovation not seen as a tool for economic growth and development. Furthermore, science, technology and innovation budgets channeled through ministries of education and planning and lack of centralized STI budgets as challenges faced by Namibia and Botswana in implementing its STI policies and Strategies.

The study further found out that understanding by different ministries and state agencies of the role of NCRST as a coordinating authority for the implementation of the research, science and technology policy of 1999 was limited due to diverging views on STI policy and competition for budgetary resources. The institutional status also led to rivalry between different R&D projects. The absence of science and technology incorporation in political parties' manifestos led to parliament not actively engaging in discourse that could accelerate the implementation of STI legal frameworks. For example, Namibia's RST Act provides for the President of the Republic of Namibia to be Patron of STI in the country, but this provision has not been implemented. Finally, the absence of the STI coordinating authorities (NCRST & BITRI) in either the Ministries of Education and of Higher & Tertiary Education and Innovation seemed to reduce their influence on sectoral ministries such as those of agriculture & water, energy & mining, fisheries, trade and industry, environment, finance and the National Planning Commission (NPC) was also identified as a challenge hindering the implementation of STI policies and Strategies for Namibia and Botswana.

6.5.5 Solutions to Improve STI Policies and Strategies

The study identified the following indicators as solutions for improving STI policies and strategies for Namibia and Botswana:

6.5.5.1 Focusing on emerging forms of innovation.

6.5.5.2 Connecting users directly with knowledge creating firm.

6.5.5.3 Ensuring policy harmonisation i.e. (STI and Industrialisation policies).

6.5.5.4 Providing incentives to researchers and scientists.

6.5.5.5 Closing the gap in the innovation value chain.

6.5.5.6 Establishment of innovation networks

6.5.5.7 Encouraging the participation of SMEs in the innovation value chain.

6.5.5.8 Establishment of national R&D funds.

6.5.5.9 Development of centers of excellence for R&D in all key research priorities

6.5.5.10 Development of Human Capital and maintaining a strong political will

6.5.6 Natural Endowments for Namibia and Botswana

Namibia and Botswana's material base are supported by their natural endowment in the form of the richness in mineral resources (Uranium, Diamond, Copper and Gold). The study further identified as enablers for effective utilisation of Namibia and Botswana's economic competitiveness and development and wealth creation:

6.5.6.1 The availability of shelter, water & sanitation, healthcare, and an educational system that is responsive to industry demands.

6.5.6.2 Contribution of Tertiary Industries to the economy (Meat and Fish exports, beverages such as Windhoek Lager in the case of Namibia), mineral processing and value addition, Tourism, Textile and Service.

6.5.6.3 Contribution of Primary Industries to the economy (mining, agriculture and energy production); the Education System at all levels (Basic, TVET & Higher Education) and the role played by the Foreign Policies and the ability to attract Foreign Direct Investment.

6.5.7 Role of Governments

Governments play a major role through the creation of an enabling environment by ensuring a strong political will and good government framework for innovation. The development of evidence based STI policies that respond to felt needs of society. Furthermore, the study identified that the establishment of patent laws to support patent sharing; provision of venture capital for startups; provision of matching funds channeled through research bodies for joint R&D projects and encouragement of the setting up of research and innovation centers within universities was way of strengthening university - industry linkages. Governments have a greater role in forging this partnership.

6.5.8 University - Industry Linkages

The National System of Innovation for developed countries like Switzerland, USA and UK is driven by a high intensity and quality of institutional linkages and collaboration among universities and research institutes. This is realised through a coordinated interactive approach involving public and private sector-based R&D institutions, universities, industry, public policy agencies and sectoral ministries for making a country's NSI functional and productive.

The quantitative research findings on university-industry linkages, indicates that most respondents agreed that the collaboration between industry and institutions is weak because most industries operating either in Namibia and Botswana are proxies of the R&D industries operating across the borders likes of South Africa and Britain.

In the case of Namibia, there is a need for the country to come up with an evidence based STI; a policy framework which aims at promoting such linkages and collaborations. Since the inception of Namibia's NSI, its R&D institutions have established different kinds of collaborations, through joint research projects and participation in regional and international programmes like the EU Horizon 2020 and STISA 2024.

In this regard, the University of Namibia and the Namibian University of Science and Technology in their quest to build a strong university-industry collaboration have been participating in several research programmes of the European Union (EU) such as the SAIS II & Demola with Finland, Phoenix project with Cardiff University, GIZ with Germany, TIKA with Turkey and DFID with the UK. They have bilateral cooperation arrangements with universities in South Africa through joint research chairs and collaborative projects of mutual benefit to both countries.

Whilst, Botswana on the other hand have reviewed its Science and Technology Policy for 1998 which include mapping its research and innovation with the assistance of UNESCO under the Global Observatory of Science, Technology and Innovation Policy Instruments (GO-SPIN) in order to strengthen its NSI. The review provided an opportunity for Botswana to strengthen its capability to develop the Policy on Research, Science, Technology and Innovation in 2011 (UNESCO, 2013). The Botswana National Policy on Research, Science, Technology and Innovation was developed by the Ministry of Infrastructure, Science aand Technology through a consultative process which involved the participation of governement entities, private sector, research sector, academia, development partners and civil society to as well as fullfilling the commitements made in the SADC Protocol on Sciecne, Technology and Innovation signed in 2008 and its Regional Indicative Strategic Development Plan (RISDP) that present science and technology as key driver for enconomic competititveness (Republic of Botswana, 2011).

Furthermore, the Government of Botswana adopted an innovation system approach during the review of the STI policy to develop an evidence based policy and an Implementation Plan to address critical issues and outline priorities to outline priority investment areas in research, science technology and innovation and how these would contribute towards the realisation of Vision 2016 and the National Development Plans (Ministry of Finance & Develoment Planning, 2007).

The University of Botswana (UB) on their research collaboration with NEPAD on the SANBio, SAIS II, the Square Kilometer Array (SKA) Radio Telescope reserch with South Africa, Botswana International Universityof Sciecne and Technology (BIUST) with UK university on big data funded by the NEWTON FUND and the Botswana Open University (BOU) were collaborating with industry and government in developing human resources needed to spearhead the development and promotion of reseach, science, technology and innovation.

Furthermore, the informants for this study found that the national R&D institutions and universities are not adequately collaborating, and university-industry collaboration is weak. Some of the barriers to university-industry collaboration or linkages identified in the study by key respondents purposefully sampled from the quantitative research design are presented below as the main obstacles:

6.5.8.1 Mismatch between R&D priorities of industry and those of universities. While industrial firms or enterprises need R&D that explicitly focuses on adding commercial value to their activities, most of the R&D activities at the universities are not organized in such ways as to target industrial needs.

6.5.8.2 Finding from government to universities as well as funding from international sources, tends to restrict the universities to R&D that is not focused on commercial interests or agendas. In some cases, funding is tied by grant stipulations or provisions that restrict university participation in industrial R&D;

6.5.8.3 Universities are just starting to develop an entrepreneurial culture and are only now formulating institutional policies that direct their R&D efforts to industrial or commercial ventures. Universities have limited internal capacities for collaboration with industry; and

6.5.8.4 Venture capital financing or funding for R&D is not easily available in Namibia; and government funding of enterprises is not adequately used to stimulate university-industry collaborations.

6.6 Conclusions

Innovation was for a long time a neglected topic in mainstream social science even though economits like schumpeter had developed the theory of innovation a centrury ago that drives long term economic and societal change its intergration into research and science policies has been a challenge (Fagerberg, 2018). A case in point here is Namibia, which had developed a good STI policy (National Research Science and Technology Policy, 1999) way back in 1999 but still the implementation of this policy was a challenge as compared to Botswana.

The long gestation period between policy formulation and implementation, i.e. Namibia took six years from 1999 to enact the Research Science and Technology Act, 2004 (Act 23 of 2004) and a further 13 years for the Research Science and Technology, Regulations 2011 to be gazetted. The proposed institutions mentioned in the policy like the National Commission on Research Science and Technology and the Research Science and Technology Fund were only established in 2013.

Whilst Botswana had its first S&T policy developed under the Ministry of Finance and Development Planning in 1996 which has undergone several reviews and new policy was development under the new Ministry of Infrastructure, Science and Technology.

Furthermore, a comparative analysis on government expenditure on R&D as a percentage of GDP and the global innovation performance (GII) of top ten performing countries in the world, including Namibia and South Africa revealed that there is a strong correlation between the increase in GERD and the country's performance on the Global Innovation Index. Namibia scored low on Knowledge & technology output compared to Botswana, South Africa and Mauritius in the SADC region and Finland, Switzerland, and Singapore.

For Namibia to improve its ranking on the GII, there is a need to strengthen institutions tasked with knowledge creation and increase the government expenditure on R&D as a percentage of GDP. The figure below indicates that Singapore, had the highest value of GERD at 2.185 percent and a GII score at 58.7 followed Finland, whose GERD as a percentage of GDP stood at 2.89 percent and GII scored for 2017 was 58.5 percent. South Africa's GERD expenditure stands at 0.765 percent of the GDP and GII score for 2017 was 35.8 percent in 2017 GII. Lastly, Namibia scored the least score of 27.9 percent in the 2017 GII report and had GRED expenditure of 0.35 percent according to the Namibia R&D survey report of 2014 (NCRST, 2016) .

The study also focused on the fifth National Development Plan (NDP5) strategies and desired outcomes under the Research and Innovation cluster, where Namibia desires to improve its ranking on the world economic competitiveness report and the Global Innovation Index from the current 97th position out of 127 countries to the 80th position currently held by Kenya. In this regard, Namibia needs to emulate Kenya's innovation performance by paying much attention to improvising its GDP expenditure on R & D, levels of Business Sophistication, market sophistication levels and knowledge & technology output capabilities.

Although, Botswana and Namibia's populations are almost similar and their natural economic endowments are also similar, the study found differences in rankings. Botswana's ranking on the World Economic Forum and Global Innovation Index reports was found to be still higher than that of Namibia in the following pillars: Botswana is better when it comes to institutions with 68.6% over 65.2% of Namibia. Also, its market sophistication Botswana scored (49.3%) compared to 39.3% for Namibia and infrastructure Botswana scored (37%) compared to 36.2% for Namibia and Knowledge & technology Output Botswana scored 15.6% compared to 7.9% for Namibia.

The study concludes that Namibia is lacking behind Botswana and needs to improve on its knowledge & Technology output and Human capital & Research through strengthening knowledge creation at institutions like universities & research centres. This would help enable them to produce the required skilled knowledge workers who can raise Namibia's competitiveness ranking in the global innovation index and world economic forum. Policy cohesion is lacking leading to many duplications in addressing innovation in Namibia and Botswana due to the absence of policy harmonisation. The study identified that visibility of the science and technology portfolio been challenged by placing STI related activities in sector ministries like agriculture, trade mining and water. This has often led to STI portfolio competing with other sectors for funding of R&D activities. Hence a recommendation to place STI in a neutral sector i.e. higher offices like Prime Minister Office or Office of the President or through National Commissions with executive powers to ensure visibility and coordination.

6.7. Policy Recommendations

This section proposes both general and specific policy recommendations that Namibia needs to follow in order to improve its competitiveness and for Botswana, what the country must maintain in terms of the policy framework for her to remain highly ranked in Africa and the world at large.

Therefore, the study extracts recommendations from the research findings on the selected research themes and proposes institutions responsible for implementation as well as providing what inputs are needed to ensure smooth implementation. Lastly the study suggests the appropriate strategies to realise the proposed recommendations from the findings.

Therefore, infrastructure development (equipment provision) should be regarded as an opportunity for retaining the qualified scientists who in return would play a pivotal role in growing the economy and creation of jobs.

6.7.1 General Recommendations

Table 5.61: General Recommendations

Research Theme	**Recommendations**	**Institution responsible for implementation**	**Inputs needed**	**Strategies**
Characteristics of effective NSI	Develop evidence-based science, technology, and innovation policy	STI coordinating authorities in both countries	Financial resources. Human resources. STI Legal & policy frameworks	Conduct policy audit to incorporate the needs of all stakeholders
Namibia Botswana STI Policy framework	Reduce long policy gestation period		Financial resources. Human resources. STI Legal & policy frameworks	Create mechanisms that reduce long policy gestation period through implementation plans with clear monitoring and evaluation
Science, Technology & Innovation resources linked to wealth creation	Ensure policy harmonisation and coordination		Financial resources. Human resources. STI Legal & policy frameworks	Build capacity of scientific personnel to address bottlenecks caused by fragmentation of STI policies.
Challenges in implementing STI polices & Strategies	Ensure strong policy coordination, coherence and political leadership		Financial resources. Human resources. STI Legal & policy frameworks	Active participation of parliamentary committee on ICT & Innovation in STI policy
Solutions to improve STI policies and Strategies	Reduce policy gestation period		Financial resources. Human resources. STI Legal & policy frameworks	Develop implementation plans with clear monitoring and evaluation
Natural endowment for Namibia and Botswana	Sustainable utilisation of natural endowment to ensure economic Development		Financial resources. Human resources. STI Legal & policy frameworks	Ensure sustainable utilisation of natural endowments for economic Development

Source: Author's own Compilation

Table 5.62: General Recommendations (cont'd)

Research Theme	Recommendations	Institution responsible for implementation	Inputs needed	Strategies
Role of Governments	Government should create an enabling environment that promote that creation of an innovation culture	STI coordinating authorities in both countries	Financial resources. Human resources. STI Legal & policy frameworks	Facilitate the linkages among key stakeholders to assist nation ability to generate, adapt and use technology effectively
University Industry linkages	Forge strong university/industry linkages	Universities & industries	Financial resources. Human resources. STI Legal & policy frameworks	Promote the linkages that lead to generation, adaptation and usage of technology and innovation

Source: Author's own Compilation

6.7.2 Specific Policy Recommendations

The study presents a heavy scholarship on national innovation system and innovation policies explaining their relationship to national economic development and competitiveness of Namibia and Botswana. However, the global competitiveness Report and the Global Innovation Index were found to lack the much-needed conceptual coherence for measuring effectiveness and efficiency of National Innovation Systems. Therefore, suggests the following policy recommendations to address the above challenge through the hamonisation of the policies (STI policy, industrial policy, and Agricultural and poverty alleviation policies) to adopt a transformative Innovation Policy Model currently championed by the UK-based Science Policy Research Unit (SPRU) that promotes Innovation Policy for sustainable development.

The tables below presents suggested specific policy recommendations that could assist policy makers and decision makers in both public and private sectors when developing and implementing evidence based STI policies.

Table 5.63: Specific Policy Recommendations

Research Theme	Recommendations	Institutions responsible for implementation	Inputs needed	Strategies
Characteristic of effective NSI	Develop evidence-based science, technology and innovation policy	NCRST & BITRI Agricultural council, diamond hub, NCHE, NQA. BIPA, BBS, BIH. Ministries responsible STI from both countries. Ministries responsible for Trade and Industry from both countries. Universities. Chambers of Commerce	Financial resources. Human resources. STI Legal & policy frameworks.	Have an education system that responds to industry demands. Governments maintaining a strong political will in championing STI. Encourage high participation of SMEs in innovation and entrepreneurship development. Having a funding framework for R&D and Innovation. Invest in the developing of knowledge workers. Forge a strong university/government and industry partnership.

Source: Author's own Compilation

Table 5.64: Specific Policy Recommendations (cont'd)

Research Theme	Recommendations	Institutions responsible for implementation	Inputs needed	Strategies
Namibia Botswana STI policy Frameworks and Strategies	Develop coherent STI policies	Ministries responsible STI from both countries. NCRST & BITRI	Financial resources. Human resources. STI Legal & policy frameworks	Remove barriers to innovation and entrepreneurship. Maintain a strong political will & leadership to drive STI. Forge a strong university/industry linkage. Ensure a dedicated funding system to support R&D & Innovation

STI resources linked to wealth creation	Reduce long policy gestation period	Parliament, Cabinet Ministries responsible for STI from both countries NPC	Financial resources. Human resources. STI Legal & policy frameworks	Build capacity of scientific personnel. Ensure increased spending of R&D as % GDP reaches 1% as proposed in SADC STI protocol and STISA 2024 Attract funding for R&D and innovation through bilateral/ multilateral engagements/joint research collaboration. Encourage active participation of scientist in the diaspora Promote technology transfer and adaptation

Source: Author's own Compilation

Table 5.65: Specific Policy Recommendations (cont'd)

Research Theme	Recommendations	Institutions responsible for implementation	Inputs needed	Strategies
Challenges in implementing STI policies and strategies	Ensure strong policy coordination, coherence and political leadership	Parliament, Cabinet Ministries responsible for STI from both countries on the policy formulation and approval phase NCRST & BITRI on the execution phase	Implementation plans with clear monitoring and evaluation Human & Financial resources	Reconfigure the institutional mandates of STI coordination authorities to give them adequate authority to coordinate STI policies and promote policy coherence across the institutional terrain in order to avoid weak policy coherence. Ensure STI is embedded in the national visions of the country. Invest in R&D infrastructure to support research. Ensure national R&D Funds are established to provide funding to R& D and Innovation. Ensure STI budgets is centralized and channeled through these established R&D Funds. Ensure STI coordinating bodies are strengthened.

Source: Author's own Compilation

Table 5.66: Specific Policy Recommendations (cont'd)

Research Theme	Recommendations	Institutions responsible for implementation	Inputs needed	Strategies
Solutions to improve STI Policies and Strategies	Reduce long policy gestation period (i.e. time taken from policy development to implementation). Namibia had its first RST policy in 1999 it took 5 years to have the RST ACT in 2004, and another 9 years for NCRST to be established	NCRST & BITRI Namibia Research & Innovation Fund Botswana research science and innovation fund	Implementation plans with clear monitoring and evaluation Human & financial resources	Ensure STI policy harmonisation to avoid duplication. Ensure STI policy implementation plans are synchronized with NDP cycles. Provide incentives to researcher and scientists. Encourage the participation of SMEs in the Innovation value chain. Develop a critical mass of skilled manpower . Maintain a strong political will and leadership that supports STI development. Encourage universities to establish R&I centers
Natural endowments for Namibia and Botswana	Sustainable utilisation of natural endowment to ensure economic competitiveness	NCRST, BIPA, BITRI, BBS, BIH	Financial resources. Human resources. Vision 2030 Vision 2016 NDP10 NDP5 STI policies	Ensure sustainable utilisation of natural endowments for economic competitiveness

Source: Author’s own Compilation

Table 5.67: Specific Policy Recommendations (cont'd)

Research Theme	**Recommendations**	**Institutions responsible for implementation**	**Inputs needed**	**Strategies**
University Industry linkages	Forge strong university/industry linkages	UNAM/NUST/UB/BUIST/industry	University research policies Financial and Human resources	Establish platforms that connects users with knowledge creataors . Providing matching funds channeled through research centers within universities
Role of Governments	Government should create an enabling environment that promote that creation of an innovation culture	Ministries responsible for STI in both countries NCRST/BITRI BIPA/BBS	Vision 2030 Vision 2016 NDP10 NDP5 STI policies Human & financial resources	Maintain a strong political will and leadership to promote the creation of an innovation culture. Facilitate the linkages among key stakeholders to assist nation ability to generate, adapt and use technology effectively.

Source: Author’s own Compilation

6.8. Areas for Further Research

The key findings and recommendations presented in this study provides lessons to all stakeholders interested in learning about the role of national systems of innovation in driving national economic competitiveness. The study was comparing Namibia and Botswana’s national systems of innovation and how they influence their economic competitiveness by leveraging on their ability to sustainably utilise its natural endowments for the promotion of investments in technology prospecting, acquisition, and technology commercialization of research output. Furthermore, the study identified a weak empirical information on the use of natural resources through technological innovation which could trigger further research to understand what is causing this anomaly.

The limited timeframe in which the study was conducted could not allow the researcher to cover a broader comparative analysis of NSIs of the entire SADC countries thereby having a holistic picture of the regional perspective. Another area seeking further research is to look at the influence of having dedicated funding structures for STI in the SADC region compared to their European counterparts in relation to economic competitiveness.

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Appendices

Appendix: A

REPUBLIC OF NAMIBIA

MINISTRY OF HIGHER EDUCATION, TRAINING AND INNOVATION

Tel. (061) 2933507
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Private Bag 13406
WINDHOEK

18 January 2017

The Director of Postgraduate Studies
University of Namibia
Private Bag 13301
Windhoek

To whom it may concern

Confirmation of Relevance and importance of the PhD studies for Mr. John Sifani (Student No. 9405917)

The letter serves as an expression by the Ministry of Higher Education, Training and Innovation's support to the PhD studies (under the topic" *A comparative study of Innovation Systems for National Economic Competitiveness in Namibia and Botswana")* by Mr. John Sifani.

There has been a growing importance attached to science, technology and innovation in Namibia with the government creating a dedicated ministry responsible for innovation coordination and development. It has further been acknowledged that for Namibia to be economically competitive, the country needs to focus more on innovation and value addition.

The proposed studies is therefore important not only to Namibia and Botswana but to the entire Southern Africa. Although there are several protocols on Science, Technology and Innovation and many national STI policies in the region, there is little information about how national innovation systems in Southern Africa leads to economic competitiveness. Furthermore, the proposed will provide solutions on how Namibia can increase its ranking on the WIPO Global Innovation Index and the World Economic Forum. It is our hope that this important study will provide Namibia with lessons of good policy and practice and also significantly contribute to the generation of new knowledge.

I wish Mr. Sifani the best in this endeavor. Should you have any questions or clarifications on the significance of this study, please do not hesitate to contact me.

I thank you.

Yours Sincerely,

MINISTRY OF HIGHER EDUCATION TRAINING & INNOVATION
OFFICE OF THE PERMANENT SECRETARY
18 JAN 2017
PRIVATE BAG 13406 - WINDHOEK

....
Dr. Alfred Van Kent
Permanent Secretary
Ministry of Higher Education, Training and Innovation

Appendix: B

UNAM

UNIVERSITY OF NAMIBIA

Quantitative Interview Questionnaire

My Name is Mr. John M Sifani, Student Number 9405917, a student pursuing my studies for a Doctor of Business Administration (DBA) degree at the Namibia Business School at the University of Namibia. The fulfillment of this qualification requires candidates to complete a dissertation that demonstrates scholarly work and a contribution to the body of knowledge. To fulfil the above, I am conducting my research under the topic "*A comparative study of innovation systems for national economic Development in Namibia and Botswana"* supervised by Prof Johannes P S. Sheefeni and Prof Kenneth Matengu.

Please be assured that the information being collected will be used for this academic work only. Confidentiality will be exercised throughout the dissertation writing process by ensuring that the information provided and information given by individuals shall not be shared with any other person. All data collected from you will be coded to protect your identity, as such; there will be no way to connect your name with the data. You are also free to withdraw from the study at any time.

Thank you for your time and valuable contribution.

John M Sifani
sifanijohn@gmail.com
Doctor of Business Administration (DBA)
University of Namibia

Section one: Background Information

1) Demographic Information

1.1 Gender

Please tick

Male ☐ Female ☐

1.2 Age

Please tick your age category in the appropriate box. Please tick only one option

Age Category	Please tick only one Category
20-24 (years)	
25-29 (years)	
30-34 (years)	
35-39 (years)	
40-44 (years)	
45-49 (years)	
50-54 (years)	
55-59 (years)	
60 and above	

2) Academic Qualifications

Highest level of education: please tick only one option

Grade Twelve	
Diploma Holder	
Degree holder	
Master Degree	
PhD or equivalent	

3) Job Category

3.1 What type of organisation do you work for?

Job Category	Please tick only one option in the appropriate boxes below
Government Office (e.g. OPM, Office of the President)	
Government Agency (ACC, NPC, Auditor General)	
Government Ministry	
SOE	
University /college (admin)	
Research Institute/center	

Private Laboratory	
Innovation hub/ institute	
Scientific body	
Research centers under Universities /Colleges	
Others	

3.2 What type of position do you hold in the organisation mentioned above?

Job	Please tick only one option in the appropriate boxes below
Chairperson of Board/Council	
Vice Chancellor/Rector	
Permanent Secretary /DPS	
Director in government O/A/M	
Director of Research/Innovation Centre	
Deputy Director	
Senior Researcher/Innovator	
Researcher/Innovator	
Engineer	

Technician	
Technology Transfer officer/specialist	
Medical Doctor/Officer	
Head of Department	
Dean	
Research Coordinator/Manager	
Other (Specify)	

4) Work Experience

4.1 How long have you been working for the organisation mentioned above?
Please tick only one option in the appropriate boxes below

Less than a year	
1-2 years	
3-4 years	
5-6 Years	
More than 6 Years	

4.2. What are your key responsibilities in the organisation? (Please tick all that relate to you)
Using the following rating scale:
Strongly Disagree =0 Disagree =1 Neutral =2 Agree=3 Strongly Agree= 4

No	Statement	Rating
1	Providing strategic leadership and guidance	
2	Policy advise and implementation of STI policy	
3	Research/Innovation funding	
5	Management of technology transfer	
6	Incubation/acceleration and startups	
7	Research Coordinator	
8	Others (please specify)	

Section Two

5) Characteristics of an Effective National System of Innovation

5.1. What are the key characteristics of an effective National System of Innovation?

Using the following rating scale:
Strongly disagree=0; Disagree=1; Neutral= 2; Agree=3 & Strongly Agree=4

No.	Statement	Rating
	Existence of evidence-based science, technology and innovation policies	
	Existence of a funding framework for R&D	
	Well defined University–Industry linkage	
	Educational system that responds to industry demand	
	Number of patents registered	
	Triple helix model for innovation	
	Supportive R&I infrastructure	
	Critical mass of skilled manpower in STI	
	High contribution from small and medium enterprise	

Using the following rating scale:

Strongly disagree=0; disagree=1; Neutral = 2; Agree=3; strongly agree=4

No.	Statement	Rating
5.2.	University-Industry linkages is one of the characteristics of an effective National System of Innovation	

Section 3

6) Namibia-Botswana STI Policy frameworks and Strategies

6.1: What are the characteristics of Namibia and Botswana`s innovation policies?

Using the following rating scale:

Strongly Disagree =0 Disagree =1 Neutral =2 Agree=3 Strongly Agree= 4

No	Statement	Rating
1	Coherent policies	
2	Removing barriers to innovation and entrepreneurship	
3	Enterprise engagement in skills formation and innovation	
4	Enhanced institutional linkages/partnerships with companies and communities	
5	Strong University Industry linkages	

6	Dedicated funding systems to support R&D and Innovation	

Using the following rating scale:

Negative=0; fairly=1; Satisfactory= 2; Good=3; Very good=4; Excellent=5

No.	Statement	Rating
6.2	What extent has Namibia and Botswana implemented innovation policies that can stimulate national economic Development	

Section 4

7) Science. Technology and Innovation wealth creation

7.1 To what extent have science, technology, and innovation (STI) contributed to Namibia and Botswana`s material base and wealth?

Using the following Likert rating scale:

Strongly disagree=0; Disagree=1; Neutral= 2; Agree=3 & Strongly Agree=4

No.	Statement	Rating
	Shelter, water, sanitation, health care & education system)	
	Rich mineral resources (Uranium, Diamond and Gold	
	Tertiary industries (meat and fish export, textile, services	
	Primary industries (mining and energy production	

	Education system (Basic TVET & Higher Education)	
	Foreign Policy (FDI)	

Using the following rating scale:

Extremely low=0; Low=1; Moderate= 2; High=3; extremely high=4;

No.	Statement	Rating
7.2	What extent can science, technology, and innovation (STI) contribute to Namibia and Botswana`s material base and wealth?	

7.3. How are science and technology resources linked to Namibia and Botswana`s Economic Development? Please select all that apply

Using the following rating scale:
Strong Disagree =0 Disagree =1 Neutral =2 Agree =3 Strongly Agree= 4

No.	Statement	Rating
	% of GDP expenditure to R&D	
	Innovation, Research, and development	
	Technology transfer and adaptation	
	Capacity building of scientific personnel	

	Active participation of scientists in the diaspora	

Sector 5

8) Challenges in implementing STI policies and Strategies

8. 5 What are the challenges faced by countries in implementing science, technology, and innovation strategies?

Using the following rating scale:
Strongly Disagree =0 Disagree =1 Neutral =2 Agree=3 Strongly Agree= 4

No.	Statement	Rating
	Lack adequate supportive infrastructure	
	If STI is not embedded in the national vision of the country	
	STI not seen as tool for economic growth and development	
	STI budgets channeled through ministries of education or planning	
	Centralize national STI budget	

Section 6

9) Solutions to improve STI policies and Strategies

9.1 How can Namibia and Botswana improve their science, technology, and innovation strategies?

Using the following rating scale:

Strongly Disagree =0 Disagree=1 Neutral =2 Agree=3 Strongly Agree= 4

No.	Statement	Rating
	Focus on emerging forms of innovation	
	connects users directly with knowledge creating firms	
	Ensure policy harmonisation. i.e. STI policy and Industrialisation policy	
	Provide incentive to researchers and scientists	
	Close the gap in the innovation value chain	
	Establish innovation networks	
	Encourage the participation of SMEs in the innovation value chain	
	Establish national R&D funds	
	Develop center of excellence for R&D in all key research priorities	
	Human capital development	

	Strong political will	
	Strengthened University _ Industry Linkages	

2. Look at basic needs, strengths, and resources that make the natural endowment for Namibia?

Using the following Likert rating scale:
Strongly disagree=0; Disagree=1; Neutral= 2; Agree=3 & Strongly Agree=4

No.	Statement	Rating
	Shelter, water, sanitation, health care & education system)	
	Rich mineral resources (Uranium, Diamond and Gold	
	Tertiary industries (meat and fish export, textile, services	
	Primary industries (mining and energy production	
	Education system (Basic TVET & Higher Education)	
	Foreign Policy (FDI)	

3. The role of government in promoting University-Industry Linkages to improve STI policies:

Using the following rating scale:
Strongly Disagree =0 Disagree=1 Neutral =2 Agree =3 Strongly Agree= 4

No.	Statement	Rating

	Establish patent laws to support patent sharing	
	Provide venture capital for start ups	
	Provide matching funds channeled through research bodies for joint R&D projects	
	Encourage the setting up of research& innovation centers within Universities	
	Provide matching funds and national support structure for SME development (establishment of research agenda)	
	Provide tax incentives or soft loans for R&D by enterprise channeled entirely or partially to Universities	
	Design national regulatory framework regarding ownership of Intellectual Property Rights (HEIs, Industry, Individual Researchers)	

Appendix C : Questionnaire for Qualitative Research

Quantitative Interview Questionnaire

My Name is Mr. John M Sifani, Student Number 9405917. I am a student pursuing my studies for a Doctor of Business Administration (DBA) degree at the Namibia Business School at the University of Namibia. The fulfillment of this qualification requires candidates to complete a dissertation that demonstrates scholarly work and contribution to the body of knowledge. To fulfil the above, I am conducting my research under the topic "*A comparative study of innovation systems for national economic Development in Namibia and Botswana"* supervised by Prof Johannes P S. Sheefeni and Prof Kenneth Matengu.

Please be assured that the information being collected will be used for this academic work only. Confidentiality will be exercised throughout the dissertation process by ensuring that the information provided and information given by individuals shall not be shared with any other person. All data collected from you will be coded to protect your identity, as such; there will be no way to connect your name with the data. You are also free to withdraw from the study at any time.

Thank you for time and valuable contribution.

John M Sifani

sifanijohn@gmail.com

Doctor of Business Administration (DBA)

University of Namibia

Section one: Background Information

1) Demographic Information

1.1 Gender

Please tick

Male ☐ Female ☐

1.2 Age

Please tick your age category in the appropriate box. Please tick only one option

Age Category	Please tick `only one Category
20-24 (years)	
25-29 (years)	
30-34 (years)	
35-39 (years)	
40-44 (years)	
45-49 (years)	
50-54 (years)	
55-59 (years)	

60 and above	

2) Academic Qualifications

Highest level of education: please tick only one option

Grade Twelve	
Diploma Holder	
Degree holder	
Master Degree	
PhD or equivalent	

3) Job Category

3.1 What type of organisation do you work?

Job Category	Please tick only one option in the appropriate boxes below
Government Office (e.g. OPM, Office of the President)	
Government Agency (ACC, NPC, Auditor General)	
Government Ministry	
SOE	
University /college (admin)	

Research Institute/center	
Private Laboratory	
Innovation hub/ institute	
Scientific body	
Research centers under Universities /Colleges	
Others	

3.2 What type of position do you hold in the organisation mentioned above?

Job	Please tick only one option in the appropriate boxes below
Chairperson of Board/Council	
Vice Chancellor/Rector	
Permanent Secretary /DPS	
Director in government O/A/M	
Director of Research/Innovation Centre	
Deputy Director	
Senior Researcher/Innovator	
Researcher/Innovator	

Head of Department	
Dean	
Research Coordinator/Manager	
Other (Specify)	

4) Work Experience

4.1 How long have you been working with the organisation mentioned above?
Please tick only one option in the appropriate boxes below

Less than a year	
1-2 years	
3-4 years	
5-6 Years	
More than 6 Years	

Section B: Semi Structured Interviews

The following questions were asked to a group of respondents purposefully sampled to provide an in-depth explanation to questions not clearing answered from the quantitative phase.

What are the key characteristics of an effective National System of Innovation?

2. What are the characteristics of Namibia and Botswana`s innovation policies?

3. To what extent have Namibia and Botswana implemented their innovation policies?

4. To what extent have science, technology, and innovation (STI) contributed to Namibia and Botswana`s material base and wealth?

5. What challenges have been encountered by Namibia and Botswana in implementing their science, technology, and innovation strategies?

6. How can Namibia and Botswana improve their science, technology, and innovation strategies?

Appendix: D - Stakeholder Interviews

List of identified stakeholders

Category	Stakeholder
Policy Layer (Macro level)	Parliamentary Standing Committee on ICT and Innovation
	Office of the President (National Planning Commission)
	Office of the Prime Minister (OPM)
	Ministry of Industrialisation, Trade and SME Development (MITSMED)
	Ministry of Higher Education Training and Innovation (MHETI)
	Ministry of Tertiary Education Research, Science and Technology (Botswana) (MTERST)
	Ministry of Agriculture, Water and Forestry (MAWF)

	Ministry of Education Arts and Culture (MEAC)
	Ministry of Investment Trade and Industry (Botswana) (MITI)
	Ministry of Environment and Tourism (MET)
	Ministry of Mines and Energy (MME)
	Ministry of Defence (MOD)
	Ministry of Information Commission Technology (MoICT)
	Ministry of Works and Transport (MT)
	Ministry of Agricultural Development and Food Security (Botswana)
	Ministry of Minerals Resources, Green Technology and Energy Security (Botswana) (MMRGES)
	Ministry of Environment, Natural Resources Conservation and Tourism (Botswana) (MENRCT)
	Ministry of Employment, Labour Productivity and Skills Development (Botswana) (MELPSD)
	SADC Science and Technology Advisor
Operational Agencies Layer (Meso level)	National Commission on Research Science and Technology (NCRST)
	Botswana Institute for Technology Research and Innovation (BITRI)
	Namibia Council on Higher Education (NCHE)
	Namibia Training Authority (NTA)

	Namibia Statistics Agency (NSA)
	Namibia Standard Institute (NSI)
	Botswana Bureau of Standards (BBS)
	Central Statistics Office (CSO)- Botswana
Research Technology Development Programme layer (Micro Level)	The Namibian Chamber of Commerce and Industry (NCCI)
	Cheetah Conservation Foundation (CCF)
	University of Namibia (UNAM)
	Namibia Energy Institute (NEI)
	Mobile Telecommunications (MTC)
	Namibia University of Science and Technology (NUST)
	Namibia Chamber of Mines (CoM)
	University of Botswana (UB)
	Botswana International University of Science and Technology
	Researchers, youth entrepreneurs and students
	Botswana University Agriculture and Natural Resources (BUAR)
	International University of Management (IUM)
	Botswana Innovation Hub (BIH)

	Namibia Business Innovation Institute (NBII)
	Desert Research Foundation of Namibia (DRFN)
	Botswana Development Corporation (BDC)
	Botswana Housing Corporation (BHC)

Appendix E: Data Code dictionary

The list below indicates a data code dictionary used in the study

EDU_QUAL stands for Educational Qualifications

EXPER stands for Years of Experience

Job_Cat stands Job Category

Position_hold stands for Position Held

Key_Responsibilities stands for key responsibilities of respondents

Char_Effective_NSI stands for Characteristic of an effective National System of Innovation

UnV_Indus_Linkage stands for University –Industry Linkages

Char_Nam_Bot_Innov_Policies means what are the characteristics of Namibia and Botswana

STI_Wealth_Cret stands for the extent at which STI contribute to Namibia and Botswana's material base and wealth

ST_Res_Link_EC means how science and technology resources are linked to Namibia and Botswana's economic Development

Chall_Impl_STI_Policies stands for challenges faced by Namibia and Botswana in implementing their STI policies

Sol_Improv_STI_Policies stands for solutions for improving STI policies

Nam_Endowments stands for Namibia's endowments

GRN_Rol_Promo_UIL stands for the role of governments in promoting University Industry Linkages to improve STI Policies.

Abbreviated Text	Explanation	Assigned Code
Gender	This explains the type of gender responding to the questionnaire	0 = "Male" 1= "Female"
Age	Age category of respondents	
	20-24 (years)	1
	25-29 (years)	2
	30-34 (years)	3
	35-39 (years)	4
	40-44 (years)	5

	45-49 (years)	6
	50-54 (years)	7
	55-59 (years)	8
	60 and above	9
EDU_QUAL	Educational Qualifications	
	Grade Twelve	1
	Diploma Holder	2
	Degree Holder	3
	Master's Degree	4
	PhD or Equivalent	5
Job_CAT	Job category of respondents	
	Government offices (OP &OPM)	1
	Government Agencies (ACC, AG, NPC etc.)	2
	Government Ministry	3
	SOE	4
	University/ College (Admin)	5
	University/ college	5
	Research Institutes /Centre	7
	Private Laboratory	8
	Innovation hub/ institute	9
	Scientific body	10
	Research centre under Universities /Colleges	12

	Others	11
Position_hold	Chairperson of Board/ Council	1
	Vice Chancellor/ Rector	2
	Permanent Secretary / DPS	3
	Director in government O/A/M	4
	Director of Research/ Innovation Centre	5
	Deputy Director	6
	Senior Researcher/ Innovator	7
	Researcher/ Innovator	8
	Engineer	9
	Technician	10
	Technology Transfer Officer/ Specialist	11
	Medical Doctor / Officer	12
	Head of Department	13
	Dean	14
	Research Coordinator/ Manager	15
	Other (Specify)	16
EXEPER	Less than a year	1
	1-2 years	2
	3-4 years	3
	5-6 years	4
	More than 6 years	5

Key_Responsibilities	Providing strategic leadership and guidance	1
	Policy advise and implementation of STI policy	2
	Research and Innovation Funding	3
	Management of technology transfer	4
	Incubation /acceleration and start-ups	5
	Research coordinator	6
	Other (please specify)	7
Char_Effective_NSI	Existence of evidence based STI policies	1
	Existence of funding framework for R & D	2
	Well defined University-industry linkages	3
	Educational system that responds to industry demand	4
	Number of Patents	5
	Triple Helix model for Innovation	6
	Supportive R&I infrastructure	7
	Critical mass of skilled workforce in STI	8

	High contribution from small and medial enterprise	9
UnV_Indus_Linkage	University Industry linkages effectiveness of Namibian be	1 to 4
Char_Nam_Bot_Innov_Policies	Coherent policies	1
	Removing barriers to innovation and entrepreneurship	2
	Enterprise engagement in skills formation and innovation	3
	Enhance institutional linkages/ partnerships with companies and communities	4
	Strong University Industry Linkages	5
	Dedicated funding system to support R&D and Innovation	6
Nam_Bot_Impl_Innov_Pol	Extent Namibia & Botswana implemented innovation policies to stimulate NEC	1 to 4
STI_Wealth_Cret	Shelter, water, sanitation, healthcare & education system	1
	Rich mineral resources (Uranium, Diamond, Gold & Zinc)	2

	Tertiary industries (meat and fish export, textile & services)	3
	Primary industries (mining and energy production)	4
	Education system (Basic, TVET & Higher)	5
	Foreign Policy (FDI)	6
STI_contri_Nam_Bot _Wealth	Extent of STI contribution to Namibia and Botswana's material base and wealth	1 to 4
ST_Res_Link_EC	% of GDP expenditure to R&D	1
	Innovation, Research and Development	2
	Technology transfer and adaptation	3
	Capacity building of scientific personnel	4
	Active participation of scientists in the diaspora	5
Chall_Impl_STI_Policies	Lack of supportive infrastructure	1
	If STI is not embedded in the national vision of the country	2
	STI not seen as a tool for economic growth and development	3

	STI budget channeled through ministries of education or planning	4
	Centralized national STI budget	5
Sol_Improv_STI policies	Focus on emerging forms of innovations	1
	Connects user directly with knowledge creation firms	2
	Ensure policy harmonisation. i.e. STI policy and Industrialisation policy	3
	Provide incentive to researchers and scientists	4
	Close the gap in the Innovation value chain	5
	Establish innovation networks	6
	Encourage the participation of SME in the innovation value chain	7
	Establish national R&D funds	8
	Develop centres of excellence for R&D in all key research priorities	9
	Human Capital Development	10
	Strong political will	11

	Strengthen University Industry linkages	12
Nam_Natural_Endowment	Shelter, water, sanitation, healthcare & education	1
	Rich mineral resources (Uranium, Diamond, Gold & Zinc)	2
	Tertiary industries (meat, fish export, textile & services)	3
	Primary industries (mining and energy production)	4
	Education system (Basic, TVET & higher education)	5
	Foreign Policy (FDI)	6
Rol_GRN_Promo_UIL	Establish patent laws to support patent sharing	1
	Provide venture capital for start ups	2
	Provide matching funds channeled through research bodies for joint R&D	3
	Encourage the setting up of research and innovation centres within Universities	4

	Provide matching funds and national support structures for SME development (establishment of research agenda)	5
	Provide tax incentives or soft loans for R&D by enterprise channeled entirely or partially to universities	6
	Design national regulatory framework regarding ownership of Intellectual Property Rights (IPR) at HEIs, Industry, Individual researchers, and innovators	7

The table below presents an explanation of codes of the dictionary and assigns a specific code to each theme and category used in the questionnaire.

Appendix G: Consent Letter

To whom it may concern

Informed Respondent's Consent to take part in the Study

This informed consent form is for researchers, innovators, policy makers and administrator in government offices/ministries/Agencies, Research/ Educational Institutions, and Industries form both Botswana and Namibia who invited to participate in a comparative study titled "Innovation Systems for National Development in Namibia and Botswana"

You may provide the following information either as a running paragraph or under headings as shown below.

Name of Principle Investigator: John M Sifani

Name of Organisation: Namibia Business School-University of Namibia

Name of Project and Version: *A comparative study of innovation systems for national economic Development in Namibia and Botswana".*

Part I: Information Sheet

Introduction

My Name is Mr. John M Sifani Student Number 9405917 a student pursuing my Doctor of Business Administration (DBA) degree at the Namibia Business School at the University of Namibia. The fulfillment of this qualification requires candidates to complete a dissertation that demonstrates their scholarly work and contribution to the body of knowledge. To fulfill the above I am conducting my research under the topic "*A comparative study of innovation systems for national economic Development in Namibia and Botswana*".

Purpose of the research

The proposed study is of importance not only to Namibia and Botswana but to the entire Southern African region. Although, there are several protocols on Science, Technology, and Innovation (STI) and many national STI policies in the region, there is not much documented information and literature on how National Systems of Innovation (NSI) in Southern Africa lead to economic Development. Hence, the study is meant to provide lessons of good policy practice and suggest best ways of improving the rankings on the WIPO Global Innovation Index and World Economic Forum reports.

Type of Research Intervention

The mixed method approach to be used in the study will be explanatory sequential mixed method because the initial quantitative data results will be explained further using qualitative data and sequential because it follows a sequence in the collection of data, analysing and interpretation of results where the researcher started by conducting quantitative research by means of a survey questionnaire followed by qualitative research using semi structured questionnaire done on key informants purposefully sampled from the sample of respondents of quantitative research of the study.

This mixed method approach will also use triangulation which will involve using more than one kind of method to study a phenomenon. This approach will be used with an understanding that quantitative and qualitative methods employed during triangulation will complement each other, providing richness or detail that would be unavailable from one method alone.

Participant Selection

Participants to the study will be selected using purposeful selection methods of key respondents in both quantitative and qualitative studies respectively.

Voluntary Participation

Participation to the study shall be done on voluntary basis as respondents shall only participate in this study upon agreeing and giving consent by signing the consent form as stipulated in Part II of this Informed Consent Form.

Procedures

Data will be collected by means of using convenient sampling techniques where questionnaires will be distributed to selected key informants using purposive sampling method where Heads of Departments in government ministries, CEOs of key research institutes, laboratories, and institutions of higher learning in Namibia and Botswana. Secondly, qualitative information of the study will be obtained from the key informants who will be sampled using a purposeful sampling method to further explain responses from phase 1 (quantitative research) of the study where semi structured interview questionnaires will be used.

Lastly, secondary data will be obtained from books, book chapters, journal articles and reports such as OECD reports, UNESCO science reports, Innovation surveys, Frascati and Oslo manuals and other documents on innovation.

The data collected from both quantitative and qualitative research will be stored for a period of five years thereafter it will be disposed.

Duration

This interview is expected to last at least for 45 minutes because it is using an online questionnaire where the respondent is required to fill the questionnaire and sent it back.

Risks

There are no major risks regarding the sensitivity of information required as the interviews questions are designed in such a way that identity of respondents is withheld and liberty is bestowed upon them not to answer any questions they feel might be too personal or classified information.

Benefits

The research topic is important to Namibia and most of Southern African countries because it goes to the fabrics and local innovation processes of societies rather than looking at research policy alone, it further proposes to investigate mechanisms that would enable effective cooperation between higher education institutions and the industry.

There will be no direct benefits to respondents participating in the study, but their inputs will help the study to find out more on how NSI influences national economic Development.

Reimbursement

The study is for academic purpose hence, ethical principles of not incentivizing respondents shall apply.

Confidentiality

Please be assured that the information being collected will be used for this academic work only. Confidentiality will be exercised throughout the dissertation process by ensuring that the information provided and information given by respondents shall not be shared with any other person. All data collected from you will be coded to protect your identity, as such; there will be no way to connect your name with the data. You are also free to withdraw from the study at any time.

Sharing the Results

Information obtained from respondents will be used only for the study and results shall be shared with public once approved by the University authorities.

The data collected from both quantitative and qualitative research will be stored for a period of five years thereafter it will be disposed.

Right to Refuse or Withdraw

This is a voluntary participative exercise where you are free to withdraw from the study at any time.

Who to Contact

For further information, please do not hesitate to contact me at the following address:

John M Sifani

P O Box 30937

Pionerspark

sifanijohn@gmail.com or jsifani@unam.na

Cell: +264 811653008

Part II: Certificate of Consent

I, ,, agree to participate in the research entitled "*A comparative study of innovation systems for national economic Development in Namibia and Botswana"* as outlined above. Furthermore, I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions I have been asked have been answered to my satisfaction. I consent voluntarily to be a participant in this study.

Print Name of Participant__________________ Signature of Participant ___________________

Date ___________________________

Part III: Statement by the researcher/person taking consent

I ,,,,,,,,,,,,,,,,,,,,,,, have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands that the following will be done:

1.

2.

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

Print Name of Researcher/person taking the consent________________________

Signature of Researcher /person taking the consent__________________________

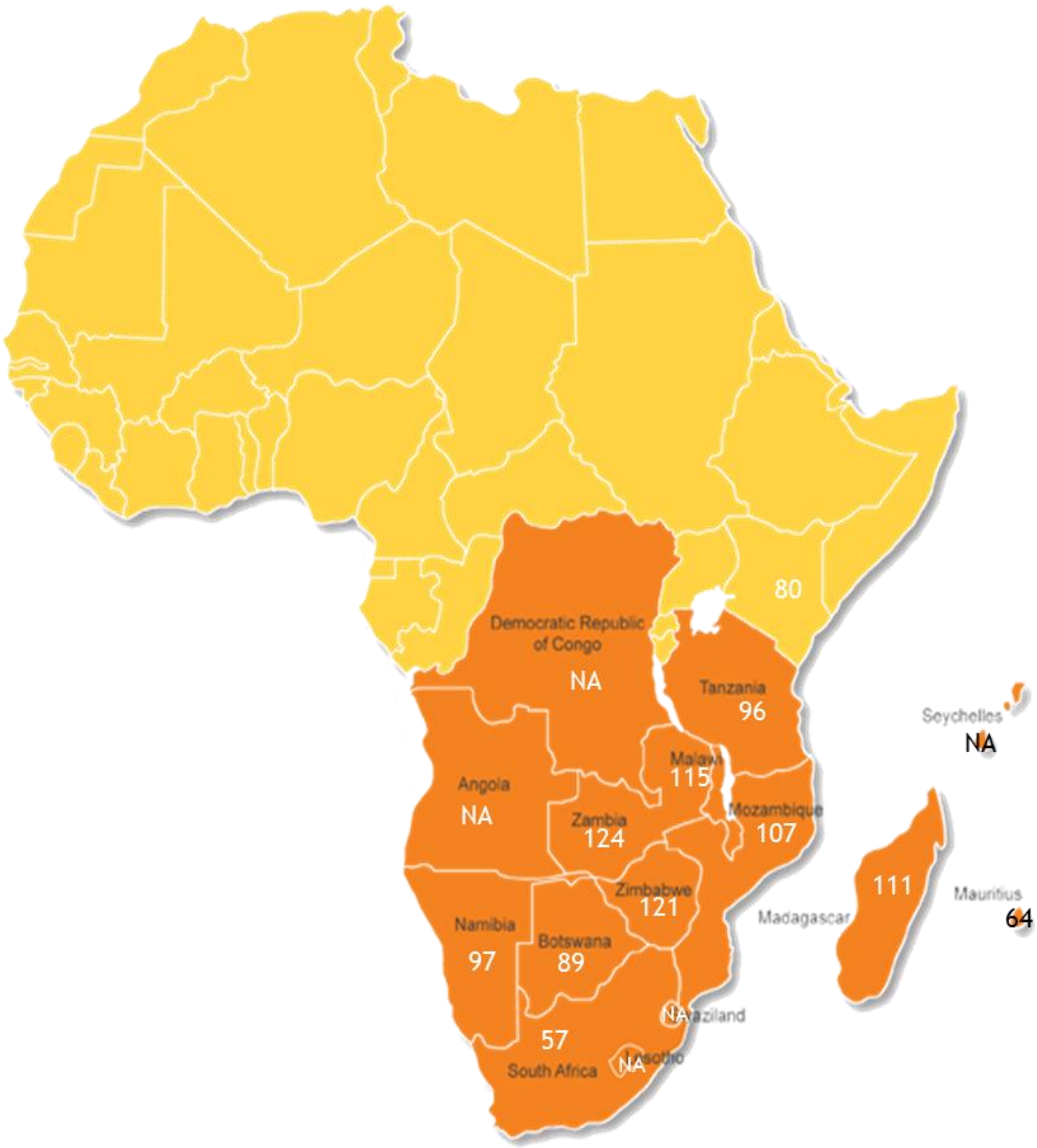
Date ______________________________

Appendix H: Demographic Statistics

Demographic Statistics

		1.1 Gender	1.2Age Category	Academic Qualifications	1.4Job Category (policy level	1.5 Position Held in the Organisation	1.6Work Experience
N	Valid	123	123	123	123	123	123
	Missing	0	0	0	0	0	0
Mean		1.41	5.03	4.18	2.42	1.53	4.49
Std. Deviation		.495	1.659	.713	.736	.793	.978
Variance		.245	2.753	.509	.541	.628	.957
Skewness		.351	.145	-.276	-.859	1.060	-1.755
Std. Error of Skewness		.218	.218	.218	.218	.218	.218
Kurtosis		-1.908	-.799	-.994	-.645	-.565	2.088
Std. Error of Kurtosis		.433	.433	.433	.433	.433	.433
Minimum		1	2	3	1	1	1
Maximum		2	8	5	3	3	5

Appendix I: GII Ranking for SADC Countries (2017)



Source: Global Innovation Index 2017

Appendix J: Descriptive Statistics Characteristic of Effective National System of Innovation

Characteristic of Effective National System of Innovations

		Demographic Information	Evidence Based STI Policies	Well defined University-Industry Linkage	Educational system that respond to industry demand	Number of Patents registered	Existence of funding framework for R&D	Critical mass of skilled manpower in STI
N	Valid	123	123	123	123	123	123	123
	Missing	0	0	0	0	0	0	0
Mean		1.41	3.58	3.61	3.50	3.48	3.54	3.54
Std. Error of Mean		.045	.066	.060	.074	.076	.071	.071
Std. Deviation		.495	.736	.661	.824	.843	.792	.792
Variance		.245	.541	.437	.678	.711	.628	.627
Skewness		.351	-1.779	-2.147	-1.982	-1.688	-1.479	-2.012
Std. Error of Skewness		.218	.218	.218	.218	.218	.218	.218
Kurtosis		-1.908	2.617	6.700	4.483	2.544	.923	4.264
Std. Error of Kurtosis		.433	.433	.433	.433	.433	.433	.433
Range		1	3	4	4	4	3	4

Minimum	1	1	0	0	0	1	0
Maximum	2	4	4	4	4	4	4

Appendix K: Overall Descriptive Statistics

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Demographic Information	123	1	2	1.41	.495
Age Category	123	2	10	5.12	1.831
Work Experience	123	1	5	4.49	.978
Academic Qualifications	123	3	5	4.18	.713
Job Category	123	1	9	4.71	1.881
Position Held in the Organisation	123	1	16	8.83	4.508
Strategic Leadership and Guidance	123	0	4	3.15	1.143
Policy advise and Implementation of STI Policy	123	0	4	3.11	1.151
Research/Innovation Funding	123	0	4	3.24	1.017
Management of technology transfer	123	0	4	3.27	1.041
Incubation/acceleration and startups	123	0	4	3.02	1.231
Research Coordinator	123	0	4	3.22	1.029

Others	123	0	4	3.08	1.258
Evidence Based STI Policies	123	1	4	3.58	.736
Existence of funding framework for R&D	123	1	4	3.54	.792
Well defined University - Industry Linkage	123	0	4	3.61	.661
Educational system that respond to industry demand	123	0	4	3.50	.824
Number of Patents registered	123	0	4	3.48	.843
Triple Helix model for innovation	123	1	4	3.50	.772
Supportive R&I infrastructure	122	0	4	3.58	.801
Critical mass of skilled manpower in STI	123	0	4	3.54	.792
High contribution from SMEs	123	1	4	3.50	.783
University Industry linkages as one the characteristic of an effective NSI	123	0	4	3.50	.833
Coherent Policies	123	0	4	3.22	.883
Removing barriers to innovation and entrepreneurship	123	0	4	2.95	1.047
Enterprise engagement in skills formation and	123	0	4	2.84	1.011

innovation					
Enhanced institutional linkages/partnerships with companies and communities	123	0	4	2.96	.953
Strong University Industry Linkages	123	0	4	2.92	.955
Dedicated funding system to support R&D and Innovation	122	0	4	3.04	.913
what extent has Namibia and Botswana implemented innovation policies that can stimulate national economic Development	123	1	4	3.28	.919
shelter, Water, sanitation, health care& education system	123	0	4	3.11	.993
Rich Mineral Resources (Uranium, Diamond, Copper & Gold)	123	0	4	3.11	.889
Tertiary Industries (meat and fish export, textiles, and services	123	1	4	3.16	.843
Primary Industries (mining and energy production)	123	0	4	2.92	.972
Education System (Basic, Secondary TVET and higher education)	123	0	4	2.89	.998

Foreign Policy (FDI)	123	0	4	2.99	1.004
what extent can STI contribute to Namibia and Botswana's material base and wealth	123	1	4	3.44	.770
% of GDP expenditure on R&D	123	0	4	3.26	.876
Innovation, Research and Development	121	0	4	3.17	.943
Technology Transfer and adaptation	123	0	4	3.14	.969
Capacity building of scientific personnel	123	0	4	3.20	.938
Active participation of scientists in the diaspora	123	0	4	3.15	.932
Lack of adequate supportive infrastructure	123	0	4	3.37	.944
If STI is not embedded in the national vision of the country	123	0	4	3.24	.950
STI not seen as a tool for economic growth and development	123	0	4	3.26	.913
STI Budgets channeled through ministries of education and planning	123	1	4	3.23	.838
Centralize national STI budgets	123	0	4	3.25	.955
Focus on emerging forms of innovations	123	0	5	3.54	.738

Connects users directly with knowledge creating firms	123	1	4	3.55	.749
Ensure policy harmonisation i.e. STI and Industrialisation policies	123	0	4	3.56	.726
Provide incentives to researchers and scientists	123	1	4	3.54	.704
Close gap in the innovation vale chain	123	1	4	3.50	.729
Establish innovation networks	123	1	4	3.44	.780
Encourage the participation of SMEs in the innovation value chain	123	1	4	3.62	.634
Establish national R&D funds	123	2	4	3.56	.655
Develop centers of excellence for R&D in all key research priorities	123	1	4	3.59	.689
Human capital development	123	1	4	3.55	.812
Strong Political will	123	0	4	3.53	.793
Strengthen University Industry linkages	123	0	4	3.39	.874
Shelter, water, sanitation, health care and education system	122	1	4	3.25	.868

Rich mineral resources (Uranium, Diamond, Copper and Gold)	123	0	4	3.24	1.001
Tertiary Industries (meat, fish export, textiles, and services)	123	0	4	3.22	.873
Primary Industries (mining and energy production)	123	0	4	3.15	.902
Education System (Basic TVET & Higher Education)	122	1	4	3.25	.796
Foreign Policy (FDI)	123	0	4	2.93	1.046
Establish patents laws to support patent sharing	123	0	4	3.23	.948
Provide venture capital for start ups	123	1	4	3.41	.789
Provide matching funds channeled through research bodies for joint R&D projects	123	0	4	3.33	.875
Encourage the setting up of R &I centers within universities	123	1	4	3.42	.849
Provide matching funds and national support structure for SME development (establishment of research agenda)	122	0	4	3.34	.977

Provide tax incentives or soft loans for R &D by enterprise channeled entirely or partially to Universities	123	0	4	3.31	.870
Design national regulatory frameworks with regards to ownership of IPR at HEI, industries and individuals	123	0	4	3.39	1.013
Age with four categories	123	1.00	4.00	2.8293	.85610
Valid N (list wise)	117				