# SOUTH AFRICAN SCIENCE DIPLOMACY: AN ANALYSIS OF KEY STRATEGIC PARTNERSHIPS

**by**

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**DECLARATION BY STUDENT.**

I, the undersigned, **GCINO QUEENETH MLABA**, do hereby declare that this Mini-Dissertation submitted to the University of Pretoria, for the degree Master of Diplomatic Studies, has not been previously submitted by me for a degree at this or any other university or similar institution, that it is my own work in design and in execution and that all material contained herein has been duly acknowledged.

10/10/21

**GCINO QUEENETH MLABA** **Date**

**DECLARATION BY SUPERVISOR.**

I, the undersigned, **Siphamandla Zondi,** hereby declare that this Mini-Dissertation by **Gcino Queeneth Mlaba** for the degree, Master of Diplomatic Studies (MDips) be accepted for examination.

Siphamandla Zondi 10 September 2021

**PROF. SIPHAMANDLA ZONDI** **Date**

# DEDICATIONS

This work is first of all dedicated to my Lord, God. To Him be the glory.

I also dedicate this mini-dissertation to my dad, Bheki Eugene Mlaba, for his example as a loving, principled, hardworking father, and humble leader of the community. For his wisdom and gift of a good education. For the afternoons I'd have to sit and read excerpts from his The Mercury and Sunday Times, dictionary in hand so that I could relate to him exactly what I understood of each article that I read. Something one did most grudgingly as an 11-year old because the cheerful sounds of my friends playing outside had me convinced that I was being punished. But how significant those sessions have proved to be in shaping my life.

I also dedicate this mini-dissertation to my mom, Ntombenhle Winnie Mlaba, for her exemplary life as a mother and for teaching me that through prayer and hard work, one could lead a productive and fulfilling life. For the values of self-respect, respect of others, unconditional love, and generosity she instilled in me. I am eternally thankful for the teachings and life opportunities she and my dad worked so hard to make available to me and my siblings.

This work is also dedicated to my sisters and nieces. As they have supported me, I hope this work motivates them to keep aiming high and committed to their goals. I also dedicate this work to my late sister, Philisiwe Bridgette Mlaba, who left us too soon but no doubt became a guardian angel continuously looking out for me. It is also dedicated to another angel, my late brother, Brightboy, who left too young but his inspiring bright light radiates through the twinkle in his eye and sweet smile in all his baby photos.

I also wish to dedicate this work to the memory of my late uncle, Dr. Sipho Mlaba, whose example and legacy are a great source of inspiration.

Lastly, I dedicate this work to three remarkable people whom I had the privilege of being managed and led by in my first professional break after university; as a young, inexperienced, unsure intern at the Presidency, Prof. Vusi Gumede, Prof. Busani Ngcaweni and Dr. Bongani Ngqulunga. Your mentorship and teachings have impacted me greatly; thank you for everything.

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## ABSTRACT

This research study critically analyses the evolving approach and implementation of South Africa's science diplomacy in a rapidly changing world. It recognizes that this environment is characterized by significant geo-political and technological shifts that have a bearing on science diplomacy. There is, as the literature shows, increasing recognition of the key role of science, technology, and innovation in addressing global challenges. The mini-dissertation begins with a description of the research theme of international science and technology cooperation involving South Africa. This is followed by a literature survey, which briefly places the study of South Africa's use of strategic partnerships as a tool to meet its science diplomacy goals in its policy and academic context. This is followed by an outline of the aim of the study, which is to critically analyze the evolving approach of South Africa's science diplomacy in a rapidly changing world characterized by significant geopolitical and technological shifts including the Fourth Industrial Revolution. The three main objectives of the study are to distill the character, approach, and role of South Africa's science diplomacy in the context of key national objectives and foreign policy interests; explore four strategic science, technology and innovation partnerships driven by South Africa- spanning the global North and South; and highlight the salient cultural, policy, institutional, and governance arrangements characterizing South Africa's science diplomacy and their implications on its role and impact. The study is based on a qualitative research design and employed a desktop review of primary and secondary documentary data available in the public domain. This study found that South Africa's science diplomacy is strongly aligned to the country's foreign policy, anchored in ubuntu diplomacy, South-South solidarity, and North-South dialogue. In addition, the study found that the state has aligned the science, technology and innovation agenda to the principles of the Constitution and has elevated the role of science and technology as an essential tool for economic growth, global competitiveness, and social development, and poverty alleviation. The state has been able to attract resources and investments to strengthen the science system while complimenting the country's foreign policy objectives. However, the study also found that as a result of various critical factors, the outcomes of South Africa's science diplomacy are severely undermined. Such factors include a lack of high-end skills; an inadequate innovation culture; flat innovation performance; the absence of a science diplomacy engagement strategy and a national innovation policy; policy incoherence, and poor governance of the science, technology and innovation system.

## LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| 4IR | Fourth Industrial Revolution |
| AAAS | American Association for the Advancement of Science |
| AfCFTA | African Continental Free Trade Area Agreement |
| APRM | African Peer Review Mechanism |
| AU | African Union |
| BRICS | Brazil, Russia, India, China, SA |
| DIRCO | Department of International Relations and Cooperation |
| DSI | Department of Science and Innovation |
| DST | Department of Science and Technology |
| EU | European Union |
| FDFA | Federal Department of Foreign Affairs |
| GERD | Government Expenditure on Research and Development |
| ICR | International Cooperation and Resources |
| IGD | Institute for Global Dialogue |
| IKS | Indigenous Knowledge Systems |
| MDGs | Millennium Development Goals |
| NACI | National Advisory Council on Innovation |
| NDP | National Development Plan |
| NEPAD | New Partnership for Africa's Development |
| NSI | National System of Innovation |
| ODA | Official Development Assistance |

| | |
|---|---|
| OECD | Organization for Economic Cooperation and Development |
| R&D | Research and Development S&T Science and Technology |
| SA | South Africa, South Africa's, South African |
| SADC | Southern African Development Community |
| SATREPS | Science and Technology Research Partnership for Sustainable Development |
| SDGs | Sustainable Development Goals |
| STI | Science, Technology, and Innovation |
| UK | United Kingdom |
| UN | United Nations |
| UNESCO | United Nations Educational, Scientific and Cultural Organisation |
| US | United States |

USAID United States Agency for International Development

# CHAPTER 1

# INTRODUCTION: AN ANALYSIS OF KEY STRATEGIC PARTNERSHIPS IN SOUTH AFRICAN SCIENCE DIPLOMACY

## 1.1. Research Theme

This study analyses South Africa's (SA) science diplomacy in this rapidly changing global world; exploring its vision, strategy and approach, and the implications of a set of cultural, policy, institutional, and governance arrangements on its role and impact. This is done through a brief exploration of four strategic science, technology, and innovation (STI) partnerships driven by the Department of Science and Innovation, (DSI) exemplifying how SA is navigating strategic North-South partnerships.

Broadly speaking, the study is concerned with science diplomacy and how it is evolving together with the emerging age of the Fourth Industrial Revolution (4IR), as an important era of innovation. The two concepts of science diplomacy and 4IR have natural proximity because of the centrality of science and technology to both of them. Science is defined as the systematic study of the structure and behaviour of the physical and natural world through observation and experiment, while technology is the application of scientific knowledge for practical purposes (Oxford Reference, 2021). In addition, the United Nations Conference on Trade and Development (2019) describes innovation as the process of using knowledge and technology to develop or improve the production or performance, of products, services and processes that have value in terms of commercial impact or social benefit. While STI are universally recognised as key drivers for poverty eradication and essential components for achieving the Sustainable Development Goals, maximising the gains of STI for the benefit of society is predicated on the development and implementation of appropriate STI policy frameworks and participatory forms of governance (UNESCO, 2020).

It is also important to define 4IR, a phenomenon of advanced technological developments that are blurring the lines between the physical, digital and biological spheres (DST, 2019: 56). It is an integration of advances in artificial intelligence (AI), robotics, the Internet of Things (IoT), 3D printing, genetic engineering, quantum computing, and other technologies and the collective force behind many products and services that are fast becoming indispensable to modern life (McGinnis, 2018: 1). Distinct from previous industrial

revolutions, 4IR is evolving at an exponential pace, with potentially significant impacts on work, services, education and leisure (Schwab, 2016). It is widely held and purported strongly by powerful international players such as the World Economic Forum (2019) that today society is undergoing an age in which S&T breakthroughs are disrupting industries, blurring geographical boundaries, challenging existing regulatory frameworks, and even redefining what it means to be human.

Since the advent of democracy in 1994, SA has made a concerted effort to use science and technology as a key instrument in foreign policy and a means to bolster economic growth for the benefit of society. Before this and during international isolation, the apartheid government channeled science and technology investments towards its narrow ends around military capability and state security, and achievements in STI were enjoyed by a privileged white minority (Pandor, 2012: 1). However, this changed in 1994 as the state sought to align the STI agenda to the principles of the constitution, a new international and continental positioning for SA, and foreign policy objectives.

SA's foreign policy is rooted in the philosophy of Ubuntu and two central tenets of Pan-Africanism and South-South solidarity (Department of International Relations and Cooperation/DIRCO, 2011: 6). The pillars of SA's foreign policy are to:

- ensure the stability of the Republic, its constitutional order, and its institutions;
- create an environment in which SA is and feel secure, and are free from want and hunger;
- prioritize the sustainable growth and development of the economy;
- prioritize the sustainable growth and development of the Southern African Development Community (SADC) region;
- commit the government to work for a stable African continent that enables peace and development to take root; and
- work towards the creation of just and equitable world order (Institute for Global Dialogue, 2014: 10-11).

As an extension of foreign policy, therefore, SA's science diplomacy approach reflects and seeks to reinforce these principles. Driving the science diplomacy agenda is entrusted to the DSI, enjoining the Department to strategically develop, promote and manage

international partnerships that strengthen the national system of innovation (NSI) and enable an exchange of knowledge, capacity, and resources between SA and its international partners, with a focus on supporting STI capacity-building in Africa, and to support SA foreign policy through science diplomacy (Department of Science and Technology/DST, 2019: 98).

In 2019, the government adopted a new White Paper on STI, which culminated from a review and update of the 1996 White Paper on Science and Technology (S&T). Responding to domestic objectives and the far-reaching and rapid changes taking place globally, the new White Paper places more emphasis on key systemic issues such as inclusion, transformation, partnerships, coherence and coordination, innovation, support to small and medium enterprises (SMEs), Fourth Industrial Revolution, and big data (DST, 2019: 68). In addition, it introduces the "whole of government and society" approach to policymaking, which underscores the need for alignment and coordination across government and key social sectors. This response to a. common observation also made by Kruss *et al* (2017), who conclude that that the key challenge for implementing a coherent cross-government national Innovation for Inclusive Development (IID) strategy in SA is the high degree of fragmentation and potential lack of synergy between government departments, rather than a lack of appropriate policy instruments.

The White Paper further emphasizes the fundamental role that STI has to play in achieving the Vision 2030 National Development Plan (NDP), Agenda 2030 Sustainable Development Goals (SDGs), and the potential of STI for African development and continental integration through Agenda 2063 (DST, 2019: 68).

Importantly, the White Paper acknowledges several key challenges constraining the contribution the national system of innovation (NSI) can make to the attainment of these objectives and, as such, highlights areas that would require attention such as the supply of high-level skills, the openness of the system, the diffusion of knowledge, and access to scientific infrastructure (DST, 2019: 44). In addition, it highlights that linkages between science and society as well as science diplomacy and internationalization are central to openness.

Essentially, it underscores that achieving the ambitions of the NDP and science

diplomacy agenda will depend on building a culture of innovation in society and developing a science-literate citizenry. The ambitions require the government to pay attention to skills and institutional arrangements to support and coordinate science engagement initiatives in SA (DST, 2019: xii). Lastly, building on a strong record of international STI partnerships, the White Paper introduces a systematic approach to expanding the internationalization of STI and science diplomacy with a strong focus on the African continent to support a pan-African agenda (DST, 2019: xii).

Generally, science diplomacy is a relatively new area of study and research in the South African context. However, it is an important 21st-century foreign policy topic due to the complexity and increasingly global nature of the most vexing challenges facing humanity and the recognition of the role of STI in addressing them. In addition, the very conduct of science and innovation has become more collaborative, international, and open to citizens (DST, 2019: 53). There is a strong case, therefore, for scholars to reflect and add on to the existing body of knowledge on science diplomacy generally, and specifically, SA's science diplomacy, and critically analyze the policy and institutional set-up underpinning it. It is also critical in the context of understanding the global knowledge structure within which it operates (Masters, 2016). Besides justifying this research theme, this chapter provides a literature survey, leading to a statement of the research problem, aim and objectives, research questions, and methodology that frame this study. Beginning with a survey of the literature is crucial because the research problem is best identified as a gap in the current studies on the subject.

## 1.2. Literature Survey

For purposes of placing the study rationale in the ongoing discussions on science diplomacy and its bearing on new foreign policy dynamics, a study must begin with a survey of literature trends. This helps us confirm the gaps in the literature that this study responds to, while it also set an academic context for the analysis that follows. The literature survey is thematic and systematic. It is divided into two broad themes: science diplomacy in a context and SA science diplomacy.

### 1.2.1. Science diplomacy in a context

Diplomacy is generally understood to be the official management of relationships

between states. According to Berridge (2015), the primary purpose of diplomacy is to enable states to secure the objectives of their foreign policies without resorting to force, propaganda, or the law (1). In addition, according to the Swiss Federal Department of Foreign Affairs (FDFA) (2008), diplomacy is how states throughout the world conduct their affairs in ways to ensure peaceful relations. The main task of individual diplomatic services is to safeguard the interests of their respective countries abroad; including the promotion of political, economic, cultural or scientific relations, and international commitment to defend human rights or the peaceful settlement of disputes" (FDFA. 2008: 3). Further, diplomatic relations can be bilateral and multilateral, with the former referring to interactions between two states and the latter between several states within the setting of an institutionalized setting of an international organization (Ibid).

The literature reveals intense debate on diplomacy linked- at first- to the defense of diplomatic theory as a discipline and then its application (traditional versus new diplomacy)- and secondly- robust ideological and academic contestation between scholars and the global North and South on the epistemologies of knowledge traditions upon which international relations and diplomatic studies are built.

Zondi (2016) asserts that the subject of diplomatic theory has in the past three decades, in particular, received a lot of scholarly attention which can be traced to three main motivations: the need to answer questions about diplomatic theory and practice, interpretation of prominent diplomats' reflections over time, and the distinction between traditional and new diplomacy (Zondi 2016: 20). Initially, the proliferation of literature on diplomatic theory was fueled by largely a defense of diplomatic theory to prove its existence, partly in response to Martin Wight's (1966:16-33) article that questioned the existence of an international theory broadly and by extension diplomatic theory (Zondi 2016: 18).

From the 1970s and over the Cold War period many prominent voices in diplomatic theory emerge by revisiting the works of Der Derian, to Niccolo Machiavelli. In this regard, the analyses by Henry Kissinger, Geoff Berridge, Paul Sharp, Martin Hall, Constantinou are crucial in reflecting on the salient principles, norms, practices, structures, and systems involved in the evolution of diplomacy. A review of this dominant literature reveals diplomatic theory heavily grounded in the Eurocentric, Western Liberal worldview based

on Western experiences, consciousness, ideas, and values. Such a worldview tends to assume a universal, state-centric, positivist, and rationalist approach to diplomatic theory and practice rejects the role of ideas and ideology in international relations.

However, these dominant theories and the universal claims they make are quite problematic and are becoming increasingly challenged and rejected in the developing world because they reflect unequal and exploitative power relations in knowledge systems. In addition, they are extremely limiting in their interpretation of human relations, events, and key features of global politics. These unequal power relations Zondi (2018, 2016) asserts have developed along the lines of coloniality of power, identity, and knowledge which has expressed itself in the growth "of Eurocentrism and its ability to conceal itself as a narrative of the modern, the rational-objective and the universal" (Zondi 2016: 20). As such in diplomatic theory, there is blatant erasure of diplomatic experiences and ideas that emanate outside the West and the silencing of voices outside Eurocentrism in its broad sense (Zondi 2016: 18).

The erasure has endured, even as the dominant discourses in diplomatic theory highlighted above have sought to "push the envelope" in terms of debate, they have been limited to the contestation between traditional diplomatic theory (TDT) and New Diplomacy Theory (NDT), with the former focused on the central role of the state in diplomacy and the latter on the diplomatic theory that emphasizes the role of non-state actors such as NGOs, international organizations and business especially after the Cold War period (Zondi 2016:19). They have also highlighted technical developments (mainly digitization) which affect how the work of the diplomat is understood; the public's sensitivity to foreign policy issues and influence through social media; and that diplomats themselves do not necessarily need the same attributes as they previously did (Stanzel 2018, Schmidt 2014).

The second set of debates in diplomacy as alluded to at the start of this section are less artificial and speak to the urgent need for a decolonial turn in diplomatic theory (Zondi, 2018, 2016; Sabaratnam, 2011) as a resistance to the traditional, rational and positivist approaches underpinning Realism, Liberalism and Marxism linked to a Eurocentric epistemology. They are a direct challenge to the European declaration of the "end of debates" which asserts that over the past century, theory development and theory testing

in IR has been exhausted, with the clear winner being Western liberalism (Fukuyama 1989).

At the heart of the problem here are epistemologies and knowledge traditions upon which international relations and diplomatic studies are built. Zondi (2018, 2016) suggests the subject of decolonization of knowledge and the social sciences is an important context for challenging current traditions. He asserts that this is linked to the need to decolonize the modern Kantian university as an institution "as an important site for the production and reproduction of Eurocentric thought, thus subtly reinforcing the racist claim that only Europeans know, others only mimic" (Zondi 2016: 18). According to Zondi (2016), the problem that haunts modern diplomacy and its theory comes from the very model of global power that came to shape the modern world, its knowledge, and its political/power arrangements since the late 15th century (Zondi 2016: 21-22).

The fundamental point is that the histories, cultures, experiences from the global South matter and are critical to re-theorizing diplomatic theory. Practically, as grand theories are not universal, global South thinking should be incorporated to explore how different actors challenge, support and shape global and regional orders, especially in the context of emerging economies and other global South states in shaping international institutions and global governance (Benabdallah et al, 20017: 2). The Global South thinkers are, therefore, being challenged not only to provide a critique of dominant IR theory and the colonial ideologies that inform them but to become even more active agents for resisting the continuity and persistence of colonial forms of power that perpetuate relations of domination and subordination (Baylis et al 2008, Dun et al 2013, Bell 1960, etc).

Global South ideologies offer fertile ground on which to build further the theory and conduct of diplomacy. For instance, the commitment to decolonization and solidarity is founded on noble principles of humanity, mutuality, self and collective reliance, harmony. etc in pursuit of the greater good (Moi, 1986). From Ubuntu to Ujama, Pan-Africanism to Pan-Asianism and Pan-Arabism, etc. these philosophies share a common sense of responsibility and duty towards not only oneself but for others based on a larger political, cultural, and historical affinities (Grovogui, 2011: 187; Madise and Mike, 2020). This represents a significantly different approach to theorizing diplomacy which recognizes and promotes the agency of human beings, life, and nature; collective effort to succeed

with others and not alone; creation of horizontal as opposed to vertical patterns of power; and a sense of responsibility outside of oneself.

### 1.2.2. The SA science diplomacy architecture

Science diplomacy is defined as scientific cooperation and engagement to address common challenges and with the explicit intent of building positive relationships with other governments and societies (DST, 2019: 10). Gluckman, et al (2017) state the two lenses that have typically defined international science cooperation are international collaboration- as either advancing knowledge and ensuring scientific capability- or advancing broader national interests. They assert that the evolving concept of science diplomacy is predominantly characterized by advancing both direct and indirect national interests such as exercising “soft power”, national security and emergency response, economic considerations, and STI on the national level. Other interests are bilateral or seek to address cross-border issues, and multilateral and designed to meet global needs and challenges such as advancing global interests such as the Millenium Development Goals (MDGs) and now SDGs and responding to global crises such as Covid-19, respectively.

The foremost cited typology of science diplomacy is from the Royal Society and the American Association for the Advancement of Science (AAAS) which categorizes three main types of activities related to science diplomacy: 1) science in diplomacy- informing foreign policy objectives with scientific advice, 2) diplomacy for science- facilitating international science cooperation, and 3) science for diplomacy- using scientific cooperation to improve relations between countries (The Royal Society, 2010: 5-12). Gluckman et al (2017) provide an alternative framing based on the reasons a country might invest efforts and resources in science diplomacy and international science through categories, namely; actions designed to directly advance a country’s national needs, actions designed to address cross-border interests, and actions primarily designed to meet global needs and challenges as described above.

The growth of “science diplomacy” as a practice and field of study in the 2000s is according to Turekian (2018) primarily driven by “the recognition that more and more, major challenges are international in nature and that science and its applications are part of the cause as well as the cure” resulting in an increasing need for the integration of

scientific cooperation in international relations (Ibid). It is possible to distinguish the different roles science diplomacy has served over its evolution. During the Cold War and at the height of political tensions between the superpowers, science diplomacy was mainly focused on the role of science as a bridge to diplomatic dialogue; which changed at the start of the 21st Century and the end of the Cold War when the focus shifted to using science to address key global challenges; and for the first time in the mid-2000s focus shifted to science diplomacy in national policy (Turekian, 2018).

The literature also reveals a clear distinction between how industrialized and developing powers make use of science diplomacy based on several factors based on national budgets and STI investments, policy-making structures and culture, institutional arrangements and capacities, etc. These include a country's scientific expertise and supply of high-end skills, the maturity of its science system, and experience in international scientific cooperation with some success factors for effective science diplomacy identified as smooth collaboration throughout government, communication and support, relationship to the science community, and access to science and technology teams (Gluckman et al, 2017). This speaks directly to the fact that the global knowledge structure is not a neutral arena but shaped unequal power relations between states which would impact knowledge production and its application.

As described in the introduction, in 1994 the democratic government elevated the role of science and technology as essential instruments not only for economic growth and competitiveness but also for social development and poverty alleviation (Pandor, 2012). In light of this dual ambition of utilizing STI to integrate and position SA internationally and continentally and address domestic socio-economic challenges, Masters (2016) describes a "two-track approach" to SA science diplomacy wherein, on the one hand, SA seeks to pursue international recognition as a "producer" and exporter of knowledge at the center of the global knowledge structure, while on the other, is a "consumer" or importer of knowledge in meeting domestic priorities. Within this global knowledge context, industrialised or developed states are the typical "producers" of knowledge, and developing states are the "consumers" (Ibid, 169).

Masters (2016) also highlights that there is a growing trend in diplomacy that identifies modes, issue areas, and tools of diplomacy with, for instance, Humanitarian Diplomacy

and Defence Diplomacy cited as modes of diplomatic practice; Economic Diplomacy and Cultural Diplomacy as tools and instruments of diplomacy; while Trade Diplomacy, Health Diplomacy, and Refugee Diplomacy as issues areas of diplomacy. An understanding of these issues, modes, and tools within the broader field of diplomacy is critical as it allows for a particular focus on an area of increasing knowledge specialization within international relations and specialization which requires an understanding of the technical details across scientific debates and the geopolitical context in which these negotiations take place (Masters, 2016: 171). However, currently, there is a gap in the literature adequately on the impact of the inequality represented by the global structure of knowledge on the role of developing states as they too look to engage in science diplomacy, whereas developed states have been able to build capacity when it comes to science diplomacy (Ibid, 172).

In SA, during apartheid and international isolation the state pursued S&T solutions to mitigate the impact of sanctions with particular attention given to the state's security through technologies such as iron processing and steel production, energy security, nuclear technology, and bio-warfare technology (Simelane 2015:43). The country's focus on the development of domestic S&T capacity resulted in several advances in sectors such as nuclear technology, coal-to-liquid (CTL) processing in producing oil, and undertaking the first human-to-human heart transplant at the Groote Schuur Hospital which achieved the country international scientific recognition, a knowledge "producer", despite its isolation (Simelane 2015:41). However, this was only to the benefit of a privileged white minority.

Since 1994, therefore, in line with the new Constitution and the democratization, integration, and transformation effort, the orientation of SA's foreign policy changed and according to the White Paper on Foreign Policy (2011), the philosophy of Ubuntu became a central tenet, along with pan-Africanism and South-South solidarity. This translated into a SA approach to IR that respects all nations, peoples, and cultures; recognizes that it is in the national interest to promote and support the positive development of others, and national security depends on the centrality of human security as a universal goal (Simelane 2015). Therefore, SA champions collaboration, cooperation, and building partnerships over conflict, and the key pillars of her foreign policy are internationalism, pan-Africanism, South-South solidarity; the rejection of colonialism and other forms of

oppression; the quest for the unity and economic, political, and social renewal of Africa; the promotion of poverty alleviation around the world; opposition to the structural inequality and abuse of power in the global system; and further support for democracy within the international system of governance (Ibid).

Indeed, these principles described above are discernible in the objectives of the DSI's international STI cooperation agenda which enjoins the Department: to strategically develop, promote and manage international partnerships that strengthen the NSI and enable an exchange of knowledge, capacity, and resources between SA and its international partners, with a focus on supporting STI capacity-building in Africa, and to support SA foreign policy through science diplomacy (DST, 2019: 98). This mandate is also informed by the NDP goals to eliminate poverty and reduce inequality and unemployment. Accordingly, this informs the mandate of the DSI's dedicated International Cooperation and Resources (ICR) Programme, which is the official driver of SA science diplomacy.

### 1.3. Research problem

Despite a long history of interaction between science and diplomacy, "science diplomacy" has been growing since the 2000s as a practice and field of study and research. In addition, due to the international nature of the major challenges facing humanity, there is increased recognition of the need for science cooperation to be integrated into international relations. There is, however, limited academic work done on the specific theme of this study, and what exists on science diplomacy generally focuses on its definition and debates linked to diplomatic theory; its role in fostering foreign relations; and its evolving application in light of major changes in the involvement of non-state actors, technology and global challenges. In the case of SA specifically, there is also an understandable focus on the break-in approach between the apartheid and democratic state.

The study of science diplomacy and linking it to 4IR is necessary considering its importance in the era of innovation and rapid technological change and its pervasive nature in all aspects of life including scientific endeavour and international cooperation itself. However, to date, there is not much done in this area. In addition, SA specifically is selected as a unit of study as a country from the global South in order to explore the

notion of New Diplomacy and the growing agency of alternative ideas from the South in reimagining diplomatic theory and practice.

Therefore, this study is designed to contribute to enriching the field by analysis of SA science diplomacy; exploring its vision, strategy, and approach, and the implications of a set of cultural, policy, institutional, and governance arrangements on its role and impact. This will be done through a brief exploration of four case studies of strategic STI partnerships driven by the DSI, exemplifying how SA is navigating engagements with strategic North-South partners in this era of rapid change. This is intended to contribute to science diplomacy knowledge and policy developments.

## 1.4. Research Question

This study is concerned with science diplomacy and how it is evolving together with the emerging age of the Fourth Industrial Revolution:

What is South Africa's approach to strategic partnerships in science diplomacy in the age of the 4IR?

## 1.5. Research Aim and Objectives

This study aims to critically analyze the evolving approach of SA's science diplomacy in a rapidly changing world characterized by significant geopolitical and technological shifts including 4IR.

The objectives are to:

- Distill the character, approach, and role of SA science diplomacy in the context of key national objectives and foreign policy interests;
- explore four strategic STI partnerships driven by the DSI, spanning the global North and South (the cases of the United Kingdom, Japan, Peoples' Republic of China, and cooperation within the southern Africa region); and
- highlight the salient cultural, policy, institutional, and governance arrangements characterizing SA science diplomacy and their implications on its role and impact.

## 1.6. Research design

This study is based on a qualitative research approach or design. Creswell 2014 describes qualitative research as an approach for "exploring and understanding the meanings that individuals or groups ascribe to a social or human problem" (Creswell 2014:4). Therefore, the process of research involves emerging questions and procedures, data typically collected in the participant's setting, data analysis, inductively building from particulars to general themes, and the researcher making interpretations of the meaning of the data (Creswell 2014;4). The study is inductive as it critically analyses the context and status of SA science diplomacy as well as that of the case studies to make observations, develop explanations, and eventually a hypothesis. As Creswell (2014) explains, the process of qualitative research is largely inductive; the inquirer generates meaning from the data collected in the field.

According to Yin (2009), the research design is "the logic that links the data to be collected (and the conclusion to be drawn) to the initial questions of study" (Yin 2009: 26). In other words, the research design is a blueprint for research and dealing with at least four problems: what questions to study, what data are relevant, what data to collect, and what data to analyze (Yin, 2009: 29). In this study, we have chosen the case study research design based on the research question and the factors/conditions under investigation. Four strategic partnerships were selected as case studies representing SA's North-South STI outlook. The choice of the case studies is based on the need to delineate four significant geopolitical and technological trends impacting the orientation of SA science diplomacy at the moment; particularly the rise of China and strategic South-South partnerships, desire for a more integrated Africa, increasing role of STI in achieving the SDGs, and the advent of the 4IR. The case studies were selected based on practical partnerships within SA's dynamic portfolio and models of international STI collaborations, which also help glean contemporary geopolitical and technological shifts the study is centered on.

Furthermore, unlike with descriptive and explanatory research questions, with exploratory questions, researchers select cases that maximize the opportunities for developing hypotheses or theories that explain the social phenomenon at stake (Bleijenbergh, 2012). In this study, the researcher seeks to analyze four cases to highlight the salient cultural, policy, institutional, and governance factors characterizing SA

science diplomacy and their implications on its role and impact. As such, it is important to select cases that represent different regions of the world and types of institutions as looking at these strategic partners will allow for some comparative analysis of experiences and the key drivers of STI.

### 1.6.1. Data Collection Method: Desktop Study

The data collection is a desktop review of primary and secondary documentary data that is available in the public domain. The secondary sources include books; impartial data in journals and academic papers. The primary data sources are official government reports, policies, and strategic documents; media reports, audio clips, and speeches. The early scoping of the area found that there was sufficient documentary evidence to base this study on and the evidence was rich and wide-ranging.

## 1.7. Research Ethics

The study was guided by the code of ethics for research set out by the University. The study is desktop research based on documentary evidence that is freely available. No confidential or sensitive official information not already in the public domain was used, as documents in the public domain were found to be sufficient for this policy-oriented mini-dissertation study. All data sources are duly acknowledged.

## 1.8. Study Limitations

The limitation of this research is that the study is primarily based on documentary data where interviews and other forms of interaction with primary actors on the ground such as foreign diplomats, government officials, analysts, and journalists would have been helpful. The Covid-19 conditions did not permit the researcher to conduct interviews as anticipated.

## 1.9. The structure of the research report:

The chapter outline of the study is as follows:

Chapter 1 lays out the focus and framework of the study. It introduces and problematizes the topic, setting out what the study intends to do and the research method to be followed.

Chapter 2 entitled 'Science Diplomacy in Context' contextualizes the growth and evolution of science diplomacy in the world and SA. Therefore, the chapter starts with defining diplomacy and highlighting key debates on old and new diplomacy. This is followed by defining science diplomacy and discussing key issues. The last part of the chapter delves into SA's science diplomacy strategy and approach.

Chapter 3 on "An Analysis of Two Strategic Partnerships in the Global South explores the two case studies representing strategic partnerships spanning the global south, being STI cooperation with China and trilateral STI cooperation in southern Africa.

Chapter 4 entitled "An Analysis of Two Strategic Partnerships in the Global North" discusses two case studies representing strategic partnerships with the global North, being STI cooperation with the United Kingdom and Japan. The chapter crystallizes the salient cultural, policy, institutional, and governance drivers of STI that have proved effective in the contexts explored.

In conclusion, Chapter 5 draws some conclusions and makes recommendations on the essential key drivers of STI elsewhere that may be considered in the SA context to institute effective cultural, policy, institutional, and governance factors to realize the ambitions of SA science diplomacy.

# CHAPTER 2
# SCIENCE DIPLOMACY: CONCEPTS, CONTEXTS, AND CONTOURS

## 2.1. Introduction

This study, as indicated in Chapter 1, is concerned with science diplomacy and how it is evolving together with the emerging age of the 4IR. These two concepts have natural proximity because of the centrality of science and technology to both of them. Before we get into the analysis in the SA context, it is important, to begin with, a discussion of the context in which science diplomacy is evolving in the world and SA. This helps us locate whatever we find on the research questions of the study in the broader canvass of developments within science diplomacy generally as well as changes that are reshaping the ancient practice of diplomacy. Such a context has the potential to provide the anchors for the main points of discussions in the analysis chapter later.

This chapter aims to outline this context, firstly by discussing the changing definition and conceptualization of diplomacy over time and during this current age of technological transformation. Secondly, by conceptualizing science diplomacy as an outgrowth of this changing nature of diplomacy, briefly describing the rise of science diplomacy in the world before shifting to the evolution of science diplomacy in SA. The aim is to describe conditions under which science diplomacy has grown in recent times in the hope that this will generate insights that will support the analysis of the central research questions of this study.

## 2.2. Defining diplomacy (debates)

Diplomacy is generally understood to be the official management of relationships between states. According to Berridge (2015), the primary purpose of diplomacy is to enable states to secure the objectives of their foreign policies without resorting to force, propaganda, or the law. In addition, according to the FDFA (2008), diplomacy is how states throughout the world conduct their affairs in ways to ensure peaceful relations. The primary role of diplomatic services is “to safeguard the interests of their respective countries abroad; including the promotion of political, economic, cultural or scientific relations, and international commitment to defend human rights or the peaceful settlement of disputes” (FDFA, 2008: 3). Further, diplomatic relations can be bilateral and multilateral,

with the former referring to interactions between two states and the latter between several states within the setting of an institutionalized setting of an international organization (Ibid).

Diplomatic theory and practice, as subsets of international relations (IR), are subject to intense debate linked to ideological and academic contestation between scholars of the global North and South, as well as changes imposed by major societal changes. The Europeans' declaration of the "end of debates" asserts that over the past century theory development and theory testing in IR has been exhausted, with the clear winner being Western liberalism (Fukuyama, 1989). This bold contention on the evolution of IR theory from the "great debates" to the end of debates presumes an end to mankind's ideological evolution and the universality of Western liberal democracy as the final form of human government. This would be true if the world comprised only North American and western European societies, as dominant theories of IR are rooted in Western experiences, consciousness, ideas, and values; and their proponents originate from these societies.

However, the hegemony of Western liberalism as an ideology and political-economic structure has to contend with new, opposing ideologies emerging from the global South which for centuries have been excluded from the "ideas marketplace" (Dunn *et al,* 2013). Mainstream IR theory has disregarded the relevance of identities, histories, values, beliefs, and ideas of those outside the West in knowledge production, which would enrich our thinking about and understanding of society, political and economic change, and world events. Zondi (2016a) asserts that diplomatic theory and practice have not escaped colonialism; the very model of global power that has shaped the modern world since the late 15$^{th}$ century, entrenching unequal and exploitative power relations between the West and global South. The Eurocentric epistemologies and knowledge traditions upon which dominant IR and diplomatic studies are based reflect the coloniality of power, identity, and knowledge and their reproduction reinforce the "racist claim that only Europeans know, others only mimic" and welcomes that erasure and silencing of diplomatic experiences and ideas from outside the West (Zondi, 2016a: 1).

This is extremely problematic as it, firstly, projects the Western school of thought as the only arbiter of knowledge and truth based on its claims of rationality and universality, excluding "knowledge" from outside the bounds of Eurocentrism (Zondi, 2016a: 33). This

is termed epistemic injustice by Zondi (2016a); a perpetuation of unequal power relations in diplomatic theory reflecting similar power relations in the global economy with powerful and weaker voices in the core and periphery, respectively. The playing field is exclusionary and undemocratic as evidenced by the "exclusion of experiences, voices, and archives of peoples outside the geopolitical West". This disregard for methods of knowledge creation and explanations of humanity and world events rooted in the collectively shared histories, experiences, ideas, beliefs, and values of the global South cannot be presumed applicable to particular realities in African, Asian, and Latin American societies.

Diplomatic theory is, therefore, yet to benefit from the radical decolonization of knowledge in pursuit of epistemic justice and an end to the imperialism of social science, in line with political, economic, and cultural justice that the whole project of decolonization and liberation entail (Zondi: 2016a: 33).

Secondly, despite protesting otherwise, grand theories of IR are directly rooted in ideology- Anglo-Saxon political thought. Western liberal democracy is a philosophy based on quantifiable material variables such as military power, economic dominance, and class struggle; and entrenches particular values and culture (individualism, materialism, consumerism, selfish competition, domination; conflict, etc.) (Howard, 1989: 10). As Howard (1989) continues, "it is a culture from which we may not ourselves be able to escape, but which we cannot expect other peoples necessarily to share." He calls on IR theorists and practitioners to be alert and empathetic to this fact and seek to take concrete steps to understand the ideologies emanating from an environment, history, and education other than Western.

Without this acknowledgment, problems with traditional diplomatic theory and practice would persist with the universalist and state-centric narrative about diplomacy, which is severely limited in explaining the role of the global South and its regions, like Africa, in changing international relations (Zondi, 2016a: 13). It is significant, therefore, that debates are ongoing within the discipline, challenging mainstream theories and driving new theory-building and re-theorizing diplomacy that goes beyond the "exclusionary premise of an imagined *Western subject* in world politics" (Sabaratnam, 2011: 7). These decolonizing strategies challenge the status quo of Eurocentric scholarship and offer

alternative accounts of subjecthood as the basis for inquiry; an essential precondition for a dialogic mode of inquiry in IR that is speaking across divides from different positions, making possible genuine dialogue as opposed to the mere conversation in the discipline (Sabaratnam, 2011: 7).

Alternative and pluralistic accounts of world politics offer IR an opportunity to transcend its imperial, colonial and racist roots and they expose the deep implications these roots have had on the ways of thinking within social theory broadly, and across theoretical divides (Sabaratnam, 2011: 18). This speaks to the unmasking of coloniality in IR that Zondi (2018, 2016a) calls for, which involves looking closely at who speaks and who does not speak in its definitive discourse; examining which civilizations, cultures, and regions of the world are privileged to have a dominant position among the voices that speak on behalf of IR. This would aptly facilitate a dialogue in the discipline; based on a provincializing of perspectives rather than an outright rejection of modes of analysis outside of the dominant perspectives (Sabaratnam, 2011: 18).

Dunn *et al* (2013) explain that the debates have evolved from inter-paradigm debates towards greater theoretical diversity and divergent views on the nature and role of theoretical plurality. The debate is no longer dominated by the dichotomy between liberalism and communism. However, the emergence of constructivist, alternative, and critical theory has been instrumental in introducing new ideas and interpretations, and as resistance to mainstream theory. The declaration of the end of debates is, therefore, premature as Bell (1960) points out that although ideological debates were being exhausted in the West, new ideologies were emerging and driving politics in Asia and Africa influenced by nationalism, ethnicity, Pan-Arabism, and other ideological conflicts in the developing world around decolonization, nation-building, religion, and economic under-development. Despite Bell's warning in the 1960s, 60 years on, new ideologies including some from Africa remain muted and side-lined as Zondi (2016a) discussed above shows.

Global economic and health crises, rising income inequality, continued economic exclusion and poverty, racism, climate change, terrorism, and rapid advancements in technology necessitate the agency of alternative ideas from the South as a response to pertinent questions. Gill (2011) explains that these overarching global crises are shaping

the political and organizational responses of the dominant global leadership and various subaltern forces; and meaningfully addressing them will require far more effective, inclusive and legitimate forms of global leadership and governance than have so far characterized the neoliberal era.

Global South thinkers are being challenged not only to provide a critique of dominant IR theory and the colonial ideologies that inform them but to become even more active agents for resisting the continuity and persistence of colonial forms of power that perpetuate relations of domination and subordination (Baylis *et a*l, 2008).

At the heart of the problem are epistemologies or knowledge traditions upon which international relations and diplomatic studies are built. As discussed earlier, Zondi (2016a) suggests the subject of decolonization of knowledge and the social sciences is an important context for challenging current traditions. In addition, alternative theories expose the limitations of the grand theories' claim to be universal and devoid of ideological, cultural, and religious influences. Theories that discount the agency of ideas, meanings, values, and beliefs in diplomacy cannot be taken seriously as they relegate entire societies and place primacy on only the Western experience.

However, the histories, cultures, experiences from the global South matter and are critical to re-theorizing diplomatic theory. Practically, as grand theories are not universal, global South thinking should be incorporated to explore how different actors challenge, support and shape global and regional orders, especially in the context of emerging economies and other global South states in shaping international institutions and global governance (Benabdallah *et al*, 20017: 2).

Further, global South ideologies offer fertile ground on which to build further the theory and conduct of diplomacy. For instance, the commitment to decolonization and solidarity is founded on noble principles of humanity, mutuality, self and collective reliance, harmony, solidarity, etc in pursuit of the greater good (Madise and Isike, 2020: 5). From Ubuntu to Ujama, Pan-Africanism to Pan-Asianism and Pan-Arabism, these philosophies share a common sense of responsibility and duty towards not only oneself but for others based on a larger political, cultural, and historical affinities (Grovogui, 2011: 187). This represents a significantly different approach to theorizing diplomacy which recognizes

and promotes the agency of human beings, life, and nature; collective effort to succeed with others and not alone; creation of horizontal as opposed to vertical patterns of power; and a sense of responsibility outside of oneself.

As indicated above, the last set of debates to be highlighted have been ushered in by major societal changes that have impacted diplomatic practice. In much of the 20th century, owing to the world wars, the Cold War, and related proxy wars; diplomacy was a subsidiary instrument of power politics and ideology Petrovsky (1998). Indeed, although the dominant theories in IR make different claims and assumptions about the international system and its actors, they fundamentally share an emphasis on political and economic power represented by military strength and economic dominance. In addition, on the proliferation of diplomatic studies in 17th century Westphalia, Murray *et al* (2011) note that diplomatic studies developed an avid focus on the state and its diplomats.

This conceptual framework of diplomacy gave diplomatic studies its identity with the key objectives of an inquiry being the state and its diplomats. Diplomacy was concerned mainly with issues of peace and war between states. However, today's interrelated global crises, the global economy, and geopolitics have challenged traditional state-based diplomacy as the state is no longer the single key actor in a more complicated and diversified diplomatic system (Murray, 2011: 5). The system, Murray (2011) continues, has come to be characterised by at least three types of diplomacy conducted simultaneously: bilateral, multilateral, and "polylateral" (state-nonstate relationships). These are key developments for diplomatic studies and IR, along with the further study of how the traditional state-centric diplomatic norms and practices might be affected or altered, if at all, by polylateralism (Murray, 2011: 5).

Newson (1989) had already earlier observed that over and above the influence of new types of diplomacy, the state-centric diplomatic agenda would also be challenged by a new set of emerging issues such as the growing number of nation-states, advancements in communications technology, and air transportation as well as the very process of rethinking IR and diplomatic theory referred to above. Further, the turn of the 21st century saw the hegemony of the "liberal idea". However, the global balance of power shifted once again due to the decline of the West and the rise of Asia coupled with a resurgence of Islam and the impact of globalization (Baylis, 2008: 425). Another shift was the

proliferation of regional and sub-regional bodies.

In addition, Stanzel (2018); Schmidt (2014); Cooper *et al* (2013); Hocking (2012); Scholte (2008) state that modern diplomacy is currently experiencing fundamental changes at an unprecedented rate, affecting the very character of diplomacy. Some of the fundamental changes related to technical developments (mainly digitization) which affect how the work of the diplomat is understood; an increase in the number of domestic and international actors whose activity implicates diplomacy (business, multinational corporations, civil society, NGOs, the media, etc); the public's sensitivity to foreign policy issues and influence through social media; and diplomats themselves do not necessarily need the same attributes as they previously did. Other issues one may be able to add include global health pandemics and the proliferation of science, technology, and innovation cooperation.

As such, diplomacy has had to adjust and adapt to address new challenges in the face of rapid technological advancements; varying actors and forms of engagement (economic diplomacy, public diplomacy, people diplomacy, science diplomacy, etc.); and new approaches to knowledge creation. Stanzel (2018) and others propose that as a start, states and diplomats should interface creatively with and coordinate the multiplicity of voices, facilitate inclusivity and community agency, embrace technology to be more efficient and agile, and constantly engage in re-skilling.

Similarly, diplomatic scholars should break free from the tried-and-tested approaches and look beyond IR and political science for theoretical foundation and tread to other academic disciplines for interdisciplinary approaches that give agency to non-state actors such as communities and the individual. In addition, they should shed and challenge the dominant Western worldview by exploring alternative experiences, values, and ideas from Africa, Latin America, and the East.

### 2.3. Old and New Diplomacy

A key part of the context of science diplomacy is illustrated by the discussions that talk about the emergence of new diplomacy after the Cold War period. While the discipline is being forced to de-center the old paradigms and the diplomatic practice is being challenged by changing realities as Stanzel shows, there are emerging new themes in

diplomatic studies.

Sofer (1988) explains, for instance, that new diplomacy was viewed as integrally linked with the concept of democracy; an expansion of the changing nature of international relations and recognition of key factors that relate directly to the conduct of foreign policy such as economics, war, national politics (leadership and governmental structures and the degree of social consensus and unity). These changes led to a demand for open diplomacy (transparency) influenced by the media and public opinion, multilateral diplomacy, and the institution of summitry and conference diplomacy; which ostensibly altered the practice and nature of diplomacy (Ibid).

This is because although these may have constituted changes in the practice of traditional diplomacy, mainly as a result of advancements in communication and transportation, they did not replace key elements of traditional diplomacy. As such, they did not alter the qualitative structure of diplomacy, nor did they change diplomatic rules or control foreign policy. These technological advancements served to make more efficient the job of the traditional diplomat as a result of faster communication to the sending state which translated to quicker and more autonomous decision-making and on issues. In addition, even if new diplomacy recognized public opinion and the media, its conduct balanced the need for openness alongside secrecy as a fundamental value of diplomacy.

Further, Sofer (1988) contends that the institutionalization of multilateral and summit diplomacy may be seen as an innovation in modern diplomacy, however, it is more a product of traditional diplomatic practices that existed before the First World War. This as diplomats are responsible for the lengthy negotiations that usually precede the conclusion of an agreement's final details by heads of state, and still, agreements concluded between top-ranking statesmen have to be maintained; nurtured, and subjected to periodic reassessment, hence “politicians are no substitute for the accumulative experience of professional diplomats abroad”.

Kumi (2014) speaks of the combined influence of new, varied players in international relations, the power of modern media, and the speed with which news travel in transforming and eroding the traditional role of state representation in foreign countries and or international forums. The proliferation of non-state actors has resulted in what has

been labeled “two-track diplomacy” (or “backchannel democracy”), many of which are not controlled by state control and tend to easily make public information that diplomatic envoys would keep secret. The challenge this poses for diplomatic practice is the need to effectively adapt to a fast-changing environment of mass media and transparency.

As a result, there is a rising expectation for professional diplomats to conduct their work in ways that not only serve their respective governments but also citizens’ interests. Diplomats have, therefore, had to master the art of public diplomacy; equipping themselves with information, knowledge, strategic analysis, and negotiation capabilities they can apply to illuminate the implications of diplomatic endeavors on citizens (Kumi, 2014: 5). This is also necessitated by prevailing political and socio-economic problems globally and in the majority of Africa states.

Lastly, Kumi (2014) highlights the rise of soft power and harmonious diplomacy linked to the prominence of international development cooperation in diplomatic relations during the decolonization process in the 1950s and throughout the 1960s. This form of diplomacy entails the transfer by wealthier nations of financial resources, expertise, and technical cooperation to less developed countries to influence developments in those countries without resorting to coercive power. This is through bilateral and trilateral Official Development Assistance (ODA), multilateral efforts such as the global frameworks for sustainable development developed at the United Nations (UN) e.g. MDGs/SDGs, and South-South cooperation between two or more developing countries.

What this discussion of new diplomacy does not take fully into consideration is how the growing agency of the global South, both at the state and non-state level, constitutes this newness in diplomacy. We now know that the voice and agency of the South have grown in the period following the Cold War as many smaller states escaped the strictures of belonging to camps. We know that many of these new actors insisted on approaches to diplomacy that reflected their geopolitical positions in the Western world, including a greater emphasis on solidarity, the infusion of concepts like ubuntu, bien vivir, sumak kawsay, and others that reflect paradigms and practices from the global periphery (Zondi, 2016b: 109). This newness is much more fundamental than merely the change of actors from state to non-state or such as it has the potential to redefine diplomacy, its practices, and its norms over time. This is an area in need of research.

### 2.4. Emerging discussions on science diplomacy

Science diplomacy refers to scientific cooperation and engagement to address common challenges and with the explicit intent of building positive relationships with other governments and societies (White Paper on STI, 2019: 10). Turekian *et al* (2018) state the two lenses that have typically defined international science cooperation are international collaboration- as either advancing knowledge and ensuring scientific capability- or advancing broader national interests. They assert that the evolving concept of science diplomacy is predominantly characterized by advancing both direct and indirect national interests, which Nuechterlein (1976) broadly describes as defense, economic, World Order, and ideological interests.

In addition, according to the Royal Society and the AAAS, there are three main types of activities related to science diplomacy: 1) science in diplomacy- informing foreign policy objectives with scientific advice, 2) diplomacy for science- facilitating international science cooperation, and 3) science for diplomacy- using scientific cooperation to improve relations between countries (The Royal Society, 2010: 5-12).

Although the AAAS definition has come to be the more eminent definition, it is important to acknowledge that others have defined science diplomacy differently. As Kaltofen and Acuto (2018) indicate, in the Anglophone world, the specific term 'science diplomacy' first appeared in 2007, giving rise to a multitude of meanings, agendas, relations, and practices. This is mainly because science diplomacy as a term lacks any fundamental theoretical grounding within IR theory, and has relied on the emerging discourse of practitioners and experts, thus becoming synonymous with the state-centric aspects of the interface between science and world politics and shaped by the converging experiences of foreign policy practitioners and esteemed members of reputable institutions representing science such as the AAAS and Royal Society.

It has also been influenced by needs and opportunity-based networks on the issue of scientific 'advice' such as the International Network of Government Scientific Advisors (INGSA), and also emerging educational initiatives and research projects such as the science diplomacy program at Tufts University and the European Commission funded 'Inventing a shared Science Diplomacy for Europe' respectively (Kaltofen and Acuto,

2018).

These combined endeavors produced the popular understanding of science diplomacy as a tool of foreign policy and, therefore, a means for advancing national interest, responding to international challenges and global good problems, as well as building science capacities in less developed countries which, in turn, would enable their governments to participate in the international collective action of science diplomacy, especially in areas of environmental protection and health (Kaltofen and Acuto, 2018). Kaltofen and Acuto ((2018) state that the above conception can be understood as the first phase or generation of science diplomacy scholarship, mainly comprised of case studies, biographical accounts from practitioners, and some limited theorizations mainly published in the renowned AAAS journal of *Science & Diplomacy* and some reflections discussions on science diplomacy across the more traditional 'IR' publications. The most dominant topics being security and the environment; followed by trade, cyber-governance, and health.

The evolving second generation of scholarship seeks to unravel the complexity of "science and politics in global action"; and concern approaches not explicitly framed in particularly theoretical terms, which are either asking about specific aspects and workings of the international politics-science interface or analyze this interface in specific empirical contexts (Kaltofen and Acuto, 2018). Within the growing literature, there are growing attempts to theorize science diplomacy beyond its operational mechanisms towards a unifying, analytical tool within IR.

Noting that the AAAS definition, although quite useful, has its limitations in that the three classifications are not always mutually exclusive, Turekian *et al* (2018) provide an alternative framing based on the reasons a country might invest efforts and resources in science diplomacy and international science through categories, namely actions designed to directly advance a country's national needs, actions designed to address cross-border interests, and actions primarily designed to meet global needs and challenges.

Actions designed to advance national needs would include exercising "soft power", national security and emergency response, economic considerations, and STI on the

national level (Turekian *et al* 2018). Further, actions designed to address cross-border interests and actions primarily designed to meet global needs and challenges concern science diplomacy to address specific bilateral or cross-border issues, and advancing global interests such as the UN SDGs and the 2030 UN agenda and responding to global crises such as Covid-19, respectively. The precursor to the SDG, the MDGs, were strong on partnerships and scientific cooperation for a successful global development agenda and the SDGs also emphasize this.

These definitions and categorizations and building on them become important as the significance of science diplomacy grows. They are useful academically and in helping states, their different ministries and agencies involved in diplomacy and science identify key areas of focus, expectations, and roles. As the next chapters will show, this is a critical issue as the coordination and execution of science diplomacy can be fraught with role confusion, fragmentation, and duplication. In addition, Turekian *et al* (2018) highlight that the distinction is critical for ministries to ensure they are equipped with and have access to appropriate expertise. For instance, they outline critical success factors for a successful science diplomat within a ministry as collaboration throughout government, communication and support, relationship to the science community, and access to science and technology teams.

While fulfilling these conditions may be easily attainable for most well-resourced, industrialized states in the West, and perhaps a country like China; with established science systems and experience in international scientific cooperation; it is not so for developing countries with modest national budgets and lacking high-end skills. This brings up the key question on the role of power in science diplomacy which requires further investigation.

Gluckman *et al* (2012) state that much of the recent discussion on science diplomacy has focused on consideration of the strategic interests of the larger advanced nations, such as the United Kingdom (UK) and the United States (US), understandably so as these nations have well established international roles and at the same time are giants in the production of new knowledge. He explains that the US, for instance, uses science diplomacy to advance its foreign policy dogma of security, prosperity, democracy, and development and would, therefore, include the use of soft power (advocating human

rights, democracy, and development) to influence developing nations as well as political and economic goals such as preserving a balance of power in the world and ensuring access to international resources and markets.

Similarly, the science diplomacy of a country like Japan also fosters fundamental foreign policy goals of security, stability, harmony, and development (Sunami, 2016). However, its science diplomacy places more emphasis on mutuality and on resolving pressing social challenges. It is rooted in three pillars: research cooperation with developing countries to resolve global problems, research cooperation with technologically advanced countries to develop cutting-edge technology, and cooperation based on an equal partnership with East Asian countries (Sunami, 2016). Good examples of the three are the Science and Technology Research Partnership for Sustainable Development (SATREPS) program, Strategic International Collaborative Research Programme, and e-ASIA Joint Research Programme (e-Asia Secretariat, 2019: 1).

As previously highlighted, bilateral and multilateral scientific cooperation are significant components of science diplomacy, facilitated by country-to-country agreements as well as a myriad of international bodies and multilateral institutions such as the UN's Educational, Scientific and Cultural Organisation (UNESCO), Conference on Trade and Development (UNCTAD), etc (UN, 2008: 6). The majority of countries, (including SA, for instance, have adopted the SDGs as the guiding multilateral policy framework for international STI cooperation (DST, 2019: 75). In addition, multilateral scientific cooperation is coordinated at the continental and regional level, for instance, in Africa by the African Union (AU) and SADC STI agencies. For example, in line with the commitment to utilize national and international resources to strengthen scientific cooperation on the continent and build capacities, SA and its sister countries drive a dynamic portfolio of bilateral and regional STI partnerships, including trilateral cooperation. These will be discussed in Chapter 3.

Further, others are driven through economic blocs such as the European Union (EU); Brazil, Russia, India, China, SA (BRICS), etc. Through BRICS, for instance, dynamic bilateral and multilateral scientific cooperation takes place between China and SA (and other partners), which is explored in-depth in Chapter 3.

## 2.5. South Africa's science diplomacy in context

Framing SA science diplomacy has to start with a broad understanding of her foreign policy. Owing to the country's history, multiracialism, and multiculturalism, the government has officially stated that SA foreign policy is rooted in the philosophy of Ubuntu ('humanity'), premised on the belief in common humanity; that "I am because we are" or that we affirm our humanity when we affirm the humanity of others. According to the White Paper on SA's Foreign Policy (2011), for instance, government embraces Ubuntu as a way of defining who SA are and how they relate to others. Ubuntu informs SA's particular approach to diplomacy and shapes her vision of a better world for all. As such, in the earlier years of democracy, SA enjoyed considerable credibility and moral authority with the international community looking to the country to play a leading role in championing values of human rights, democracy, reconciliation, and the eradication of poverty and underdevelopment.

It is further elaborated in the White Paper that Ubuntu translates into a SA approach to IR that respects all nations, peoples, and cultures; recognizes that it is in the national interest to promote and support the positive development of others; and national security depends on the centrality of human security as a universal goal (DIRCO, 2011: 4). Therefore, SA champions collaboration, cooperation, and building partnerships over conflict, and the key pillars of her foreign policy are internationalism, pan-Africanism, South-South solidarity; the rejection of colonialism and other forms of oppression; the quest for the unity and economic, political, and social renewal of Africa; the promotion of poverty alleviation around the world; opposition to the structural inequality and abuse of power in the global system; and further support for democracy within the international system of governance (DIRCO, 2011: 11).

The IGD (2014) advises that SA foreign policy broadly guides the country's international engagement aimed at creating a better SA, 'contributing to a better and Safer African and a better world and four objectives are identified through which SA seeks to realise this vision, namely through bilateral and multilateral interactions, to protect and promote SA's national interests and values; protect SA's sovereignty and territorial integrity; contribute to the formulation of international law and enhance respect for its provisions; and promote multilateralism to secure a rules-based international system.

In addition, it is important to highlight the main pillars of SA's national interest pronounced as to:

- ensure the stability of the Republic, its constitutional order, and its institutions;
- create an environment in which SA is and feel secure, and are free from want and hunger;
- prioritize the sustainable growth and development of the economy;
- prioritize the sustainable growth and development of the SADC region;
- commit the government to work for a stable African continent that enables peace and development to take root; and
- work towards the creation of just and equitable world order (IGD, 2014: 10- 11).

Informed by the vision, objectives, and pillars, the six strategic priorities of SA's foreign policy, therefore are articulated as to:

1. **Enhance the African agenda and sustainable development:** among others, to promote democracy, good governance, human rights, peace and security, and sustainable development on the African continent through the structures and processes of the AU and its Peer Review Mechanism (APRM); strengthen mechanisms of the AU and SADC; promote the implementation of the New Partnership for Africa's Development (NEPAD); contribute to the processes for the peaceful resolution of conflicts, peace missions, election observer missions, and Post-Conflict Reconstruction and Development (PCRD); provide technical and development cooperation through capacity-building, skills transfer and project funding to identified countries,

2. **Strengthen political and economic integration of SADC:** by contributing to SADC processes, to create an enabling and supportive environment of political and economic integration as well as the effective functioning of the regional organisation,

3. **Strengthen South-South cooperation** by engaging identified organisations and formations of the South, to contribute to, and advance common positions of the South, reflecting SA's foreign policy priorities,

4. **Strengthen relations with strategic formations of the North:** This means to engage with groupings of the North concerning the promotion of national priorities, the African Agenda and the Agenda of the South, through dialogue and participation in summits, and ministerial and senior officials' meetings,

5. **Participate in the global system of governance**: contribute to the peaceful resolution of international conflicts with the centrality of the UN Charter and the principles of international law; contribute towards global peace and security, political and socio-economic stability; promote and protect human rights; advocate for the reform of global governance institutions and their secretariats to better address the needs of developing countries, etc), and

6. **Strengthen political and economic relations**: consolidation and strengthening of bilateral political and social relations through structured bilateral mechanisms and high-level engagements; consolidation and strengthening of bilateral economic relations through the promotion of value-added exports, targeted foreign direct investment (FDI), tourism promotion, and development cooperation.

The nature of SA's science diplomacy fits snugly into the AAAS definition and expanded the definition by Turekian *et al* (2018). As pointed out by the former Minister of Science and Technology, Naledi Pandor (2012) SA's science diplomacy agenda focused on three areas 1) diplomatic efforts to promote international scientific cooperation, 2) international scientific cooperation to address political and economic developmental goals related to foreign policy, and 3) the science content of topical international relations issues and the diplomatic effort required to deal with them.

The underpinnings of SA science diplomacy are widely attributed to the political transition from apartheid to democracy in the early 1990s. During international isolation, the apartheid government channeled science and technology investments towards its own narrow ends around military capability and state security (Masters, 2016: 174). Achievements in STI were enjoyed by a privileged white minority. However, this changed with the advent of democracy in 1994, as the democratic state sought to align the STI agenda to the principles of the Constitution, a new international and continental positioning for SA, and foreign policy objectives. Pandor (2012) explains that the

democratic government elevated the role of science and technology as essential instruments not only for economic growth and competitiveness but also for social development and poverty alleviation.

This dual ambition of utilizing STI to integrate and position SA internationally and continentally, as well as to address domestic socio-economic challenges, raises what Masters (2016) terms a “two-track approach” to SA science diplomacy. She contends that SA, on one hand, seeks to pursue international recognition as a “producer” and exporter of knowledge at the center of the global knowledge structure, while on the other, is a “consumer” or importer of knowledge in meeting domestic priorities. This extends to regional priorities as well.

This is an important point to note concerning the dynamics of power in international relations as Masters (2016) captures Susan Strange’s (2015:31-35) articulation of four sources of power in international relations: security, production, finance, and knowledge. On knowledge, it has been noted that “knowledge is power and whoever can develop or acquire and to deny the access of others to a kind of knowledge respected and sought by others; and whoever can control the channels by which it is communicated to those given access to it, will exercise a very special kind of structural power” (Strange, 2015: 33).

In a world where STI is increasingly integral to addressing national and global challenges, SA finds itself in the position of other developing countries on the science, technological, economic, political, and military margins of the world as a net consumer, rather than a producer, of usable knowledge (Masters, 2016: 2). Generally, this is due to poverty, and the lack of resources and high-end skills. In this way, developing countries find themselves in a position where, as “consumers” of knowledge, the emphasis is on attracting STI in support of their development priorities, rather than exporting, presenting, or “producing” their own knowledge. (Masters, 2016: 2). Consequently, science diplomacy discussions and literature are predominantly located within developed or industrialized nations, with little input from developing countries.

An additional matter highlighted by Masters (2016) linked to the unequal power relations in the global knowledge structures is the growing trend in diplomacy that identifies

different modes, issue areas, and tools of diplomacy with, for instance, Humanitarian Diplomacy and Defence Diplomacy cited as modes of diplomatic practice; Economic Diplomacy and Cultural Diplomacy as tools and instruments of diplomacy; while Trade Diplomacy, Health Diplomacy, and Refugee Diplomacy as issues areas of diplomacy. An understanding of these issues, modes, and tools within the broader field of diplomacy is critical as it allows for a particular focus on an area of increasing knowledge specialization within international relations and specialization which requires an understanding of the technical details across scientific debates and the geopolitical context in which these negotiations take place (Masters, 2016: 171). Due to a myriad of reasons including their economic and technological advancements and a strong knowledge base in STI base developed countries tend to enjoy this specialized technical capacity while developing nations do not.

Acknowledging these shortfalls in capacity and resources, including the challenge of brain drain to developed nations, Masters (2016) concludes that SA reflects elements of both a developed and developing country in its pursuit of science diplomacy. In the first instance, the country has followed a similar path to that of developed countries, exporting produced knowledge to countries on the periphery of the global knowledge structure in advancing its own scientific capabilities. In the second instance, and owing to pressing domestic challenges, SA has placed additional emphasis on the second track of science diplomacy as a "consumer" and an importer of knowledge. These ideas and examples are expanded on in Chapters 3 and 4.

But this rare analysis of SA's science diplomacy has hallmarks of pioneer studies in that it focuses a lot more on broad frames of science diplomacy in SA than on the details about how it is implemented. Early studies have to set the tone for future and more in-depth studies by surveying the lay of the land, provide definitional clarity, identify the key pillars of the phenomenon, and relate it to global trends. These studies do this very well. What remains, which this study attempts, is to further elaborate how this science diplomacy has been used to advance foreign -policy objectives including those related to social, developmental, and economic cooperation.

## 2.6. SA science diplomacy architecture

By architecture, we mean arrangements that indicate key role players and the role they play, the governance model behind science diplomacy. This section straddles contextual explorations with in-depth discussions about science diplomacy in practice in SA. Understandably, it draws a lot more from primary sources in the form of policy and official documents than the academic literature. Indeed, the points made in the previous section are discernible in the objectives of the DSI (formerly DST) international STI cooperation agenda. The DSI plays a leading role in science diplomacy, while its work is required to be aligned with a national agenda in which all departments contribute. This agenda enjoins the Department to strategically develop and manage international partnerships that strengthen the NSI and support capacity building on the continent and support SA foreign policy through science diplomacy. Along with the rest of the Department, this mandate is informed by the NDP goals to eliminate poverty and reduce inequality and unemployment. This is therefore a fundamental expression of SA's national interests and a key part of the strategy is to direct and mobilize the NSI to complement efforts towards inclusive economic growth and transformation, build capabilities, and state capabilities to address complex challenges (National Advisory Council on Innovation/ NACI, 2019: 19).

In addition, as will be explored in more detail later in this chapter, informed by its key foreign policy priorities to enhance the African Agenda and sustainable development, and strengthen political and economic integration of SADC, SA has emphasized in its STI agenda the objective to access international capacities and resources to strengthen cooperation in STI in Africa to build capacities and support initiatives of SADC and AU (DSI, 2020b: 80).

The DSI is responsible for developing and driving STI policy in SA, providing resources for public research and innovation, and leading the science diplomacy competency (DSI, 2020b: 80). This DSI executes its mandate through agencies and science councils over which it has oversight including the National Research Foundation (NRF), Technology Innovation Agency (TIA), SA National Space Agency (SANSA), Council for Scientific and Industrial Research (CSIR), Human Sciences Research Council (HSRC), National Advisory Council on Innovation (NACI), Academy of Science of SA (ASSAf), and SA Council for Natural Scientific Professions (SACNASP).

In addition, the DSI works closely with sister departments with a public research policy and

funding mandates such as the Departments of Higher Education and Training (recently combined with DSI under one Minister for Higher Education, Science, and Technology), Environmental Affairs, Trade, and Industry, etc. and agencies such as the Water Research Commission (WRC), SA National Energy Development Institute (SANEDI), Medical Research Council (MRC), etc. In driving science diplomacy in particular, the DSI works closely with the Department of International Relations and Cooperation (DIRCO). The Department also works intimately with Universities, accounting for a large share of funding for university-led research and development (R&D), as well the private sector, and to a limited degree Non-Governmental Organisations (DST, 2019: 33).

For 23 years since democracy, the DSI derived its mandate from the 1996 White Paper on Science and Technology which was reviewed and updated into the 2019 White Paper on Science, Technology and Innovation: *Science, technology and innovation enabling inclusive and sustainable South African development in a changing world* (DST, 2019: 27). In response to current trends globally and domestically, the new White Paper places more emphasis on key themes such as inclusion, transformation, partnerships, coherence and coordination, innovation, support to small and medium enterprises (SMEs), 4IR, big data, etc. The White Paper further emphasizes the fundamental role that STI has to play in achieving the SDGs and the potential of STI for African development and continental integration (DST, 2019: 15).

The White Paper further introduces a systematic approach to expanding the internationalization of STI and science diplomacy, with a strong focus on the African continent to support a pan-African agenda and strategic North-South partnerships; as well as South-South cooperation particularly with partner countries such as China (DST, 2019: 39). Accordingly, the broad mandate of the DSI's dedicated ICR Programme, which is the official driver of SA science diplomacy, is two-fold, namely to strategically develop, promote and manage international relationships, opportunities, and S&T agreements that strengthen the NSI and enable an exchange of knowledge, capacity, and resources between SA and international partners, with a focus of capacity-building in Africa. Secondly, it is to support foreign policy through science diplomacy (DST, 2019: 79).

As such, SA's diverse range of STI relationships are directed at four main strategic

objectives: to access international funds to complement SA's national investments in STI; enhance national STI capabilities through access to international knowledge capacities and resources; strengthen cooperation in STI in Africa to build capacities and support initiatives of SADC and AU for the advancement of national and Africa's growth and development agenda; and maximize SA's strategic interests in international cooperation in STI in support of foreign policy objectives and international trade and investment partnerships (DSI, 2020a: 39).

The Department's ICR Programme is actively promoting such partnerships with countries, development cooperation agencies, philanthropic organizations, and foundations, and multilateral bodies making resources available to complement the DSI's core themes including the economy, hydrogen, and fuel cell technology, space S&T, and innovation for inclusive development (DST, 2019: 99).

In pursuit of domestic objectives and recognizing the far-reaching and rapid changes taking place globally, the White Paper places emphasis on the need to address key systemic issues such as inclusion, transformation, fragmentation, innovation, digitalization etc. (DST, 2019: 68). The White Paper further emphasizes the fundamental role that STI has to play in realizing the NDP's vision, SDGs, and potential of STI for African development and integration through Agenda 2063 (DST, 2019: 68). It would be critical for SA to address constraints to the supply of high-level skills; the openness of the system including through science diplomacy internationalization; the diffusion of knowledge; and access to scientific infrastructure (DST, 2019: 44).

The White Paper underscores that realising the NDP's vision and science diplomacy agenda will depend on building an innovation culture in society and developing a science-literate and aware citizenry and mandates the government to pay attention to skills and institutional arrangements to support and coordinate science engagement initiatives in SA (DST, 2019: xii). Lastly, building on a strong record of international STI partnerships, the White Paper introduces a systematic approach to expanding the internationalization of STI and science diplomacy.

The rationale for strengthened international partnerships is based on that historically STI partnerships have granted SA access to cutting-edge research infrastructure that cannot

be duplicated in the country; and have provided local scientists with an opportunity to research the frontier of knowledge; attracted prominent visiting scientists to the country; extended the Ph.D. and Master's supervisory capacity; provided opportunities for training, and skills and technology transfer; contributed significantly to the internationalisation of SA world-class research, enhanced the country's visibility and footprint in the international scientific community; and leveraged international research funding from new partnerships (DST, 2019: 74).

## 2.7. Conclusion:

We have found no academic analysis conducted that reflects on this crystallisation of the science diplomacy agenda. This study contributes to reflecting how the key objective of building strategic partnerships is translated into reality, but many other areas are arising from the White Paper alone that deserve probing further and deeper.

This chapter has contextualized the growth and evolution of science diplomacy in the world and SA. It defined diplomacy and highlighting key debates in IR theory and diplomatic studies linked to the clarion call for the decolonization of knowledge and re-theorizing diplomacy. The chapter also discussed debates on old and new diplomacy. This was followed by a section defining science diplomacy and discussing key issues including its evolution with the emerging 4IR. The last part of the chapter articulated the key pillars of SA's foreign policy as a foundation for its science diplomacy. It then unpacked SA's science diplomacy vision, strategy, and approach.

Chapters 3 and 4 that follow will reflect on four strategic partnerships spanning different global regions: the South and North. Chapter 3 will address the global South by exploring SA's STI cooperation with China as well as cross-border trilateral cooperation in southern Africa. Chapter 4 will address the global North by exploring STI cooperation with the UK and Japan. Chapter 4 will end with crystalising the salient cultural, policy, institutional, and governance drivers of STI which SA might consider in bolstering its system.

# CHAPTER 3

# A STRATEGIC PARTNERSHIP WITH CHINA AND TRILATERAL STI COOPERATION WITH SOUTHERN AFRICAN COUNTRIES

## 3.1. Introduction

As mentioned in the previous chapter, owing to her history and constitutional principles, SA's foreign policy is- among others- rooted in two central tenets: Pan- Africanism and South-South solidarity (DIRCO, 2011: 6). To SA, the realisation of national interests and the promotion and advancement of stability, unity, and development on the continent; particularly in the SADC region, are mutually inclusive. In addition, over and above the historical and aspirational solidarity, recent geo-political shifts have seen strengthening relations between SA and the emerging powers of the east at bilateral and multilateral levels. Diplomatic and trade relations with China, India, and Japan, as well as cooperation through the BRICS formation, for instance, are held in very high official regard.

Although discussed in more detail in Chapter 2, because this explains the strategic partnerships it is worth reiterating the vision of SA's international engagement for a better SA, 'contributing to a better and safer Africa, and a better world' and fundamental pillars of SA's foreign policy which are to 1) enhance the African agenda and sustainable development, 2) strengthen the political and economic integration of SADC, 3) strengthen South-South cooperation, 4) strengthen relations with strategic formations of the North, 5) participate in the global system of governance, and 6) strengthen bilateral political and economic relations (IGD, 2014: 9, 10, 11).

As an extension of foreign policy, therefore, SA's science diplomacy reflects and seeks to reinforce these patterns of international engagement. As alluded to in Chapter 2 the dual approach of prioritising cooperation with the global North and South serves to cater for SA's simultaneously role as a "producer" and exporter of knowledge within the global knowledge structure and a "consumer" or importer of knowledge in meeting domestic and regional priorities (Masters, 2019: 177).

Generally, the latter applies to SA's engagement in STI cooperation with fellow developing countries from the East and South while the former to engagements with developed countries from the West and North bilaterally and or multilateral forums.

However, there are factors such as an individual country's level of economic and scientific advancement, that give SA latitude in applying this dual approach within bilateral and multilateral partnerships. For instance, while the BRICS relationship may be classically South-South cooperation, SA's STI cooperation goals with China or India, would also include attracting massive investments and resources into the country just based on their economic size.

Similarly, SA's geographical advantage and cultural diversity, for instance, lend her prime position in global STI cooperation on disciplines such as palaeosciences, climate change/Earth Systems research, Antarctic and marine research, and Indigenous Knowledge Systems (IKS) (DSI, 2020: 86). Chapters 3 and 4, therefore, expand on SA's science diplomacy approach through specific strategic partnerships and demonstrate how the approach is directed to advance national needs, cross-border interests, and global needs and challenges as described by Turekian *et al* (2018).

As the official custodian of SA's science diplomacy, the DSI bears the responsibility to develop, promote and manage strategic international relationships, opportunities, and agreements to strengthen the NSI and promote SA as a preferred international partner for STI initiatives. This chapter, firstly, explores key policy insights of SA's fledging strategic STI partnership with the People's Republic of China on SA-China Science Park Cooperation. The second part reflects on trilateral STI cooperation with southern African countries to strengthen capabilities and support growth and development objectives.

### 3.2. A glance at SA's STI international partnerships

Through the White Paper on STI of 2019, the SA government has introduced a systematic approach to expanding the internationalisation of STI and science diplomacy, with a strong focus on building partnerships with strategic partners in Africa and elsewhere such as with China. As outlined in Chapter 2, the DSI's international competence has a two-fold purpose, namely: to strategically develop, promote and manage international relationships, opportunities, and S&T agreements that strengthen the NSI and enable an exchange of knowledge, capacity, and resources between SA and international partners, with a focus of capacity-building in Africa. Secondly, it is to support foreign policy through science diplomacy (DSI, 2020: 79).

As we discussed earlier, SA's diverse range of STI relationships are, therefore, directed at four main objectives: to access international funds to complement SA's national investments in STI; to enhance national STI capabilities through access to international knowledge capacities and resources; to strengthen cooperation in STI in Africa to build capacities and support initiatives of SADC and AU for the advancement of national and Africa's growth and development agenda, and to maximise SA's strategic interests in international cooperation in STI in support of foreign policy objectives and international trade and investment partnerships. Judged against the first three strategic objectives (the fourth objective is most relevant to Chapter 4), SA's STI partnerships have been beneficial to the national and regional NSI, and to a limited degree broader society, at least when measured by the monetary value of partnerships as will discussed in more detail later in the chapter.

The centrality of Africa in SA's science diplomacy according to formal documents cannot be overstated (DIRCO, 2011; IGD, 2014; DST, 2019; DSI: 2020a). Highlighting some of the potential benefits of the recently launched African Continental Free Trade Area Agreement (AfCFTA), the Minister of International Relations and Cooperation, Dr. Naledi Pandor remarked in the 2019 DIRCO Budget Vote Speech that, "SA has excellent research universities, trains a large number of African post-graduate students and absorbs only a small number of them. We also have very competent research councils, imagine the contributions we could make to Africa if we multiply this capacity. The development in potential of a vibrant Africa-based knowledge economy would become a genuine reality. Our capacity for innovation must become part of our diplomatic interactions and be utilised to advance our continent's interests" (DIRCO, 2019).

On SADC, she further notes that "the Engineering Needs and Numbers Study has been concluded and will assist Member States to implement programmes for developing enhanced engineering training at national or regional platforms to enable career development through sharing of experience and expertise. Furthermore, Member States were also urged to introduce Science, Technology, Engineering and Mathematics (STEM) subjects at early stages in the education systems to increase the number of students able to take up studies in engineering fields" (DIRCO, 2019). Developing these skills is critical to human capital development needed to realise the full potential of STI

to support Africa's socio-economic development and competitiveness in global research and innovation as articulated in the Science, Technology, and Innovation Strategy for Africa (STISA) 2024; which aims to transform Africa into a Knowledge-based and Innovation-led Society.

The range of international STI partnerships and engagements has seen notable gains to expand and strengthen the NSI. For instance, SA has seen a steady increase in opportunities for the NSI to access international resources and support for research, innovation, and HCD programmes or research infrastructure. In the 2018/19 financial year, for instance, an investment of R517 million into local institutions was reported by international partners compared to R448 million in the previous year (DSI, 2019: 80). In the same period, R3 347 billion was invested by international partners in their organisations and initiatives targeted at collaboration with SA, an increase from R1 199 billion reported in 2017/18.

In addition, in the same period about 1 500 SA students were reportedly participating in international training programmes offering a postgraduate qualification as part of cooperation initiatives from 241 students in 2017/8, while 36 international technical exchanges to build or reinforce SA's capacities in key STI domains were undertaken with the support of international partners.

Further, in 2018/19 just over R90 million in international funds was directly invested in African regional and continental research, innovation, and HCD or research infrastructure programmes; with 93 projects co-funded or supported in kind by the DSI and at least one other African partner; and 17 AU or SADC STI initiatives or governance frameworks endorsed at AU or SADC Ministerial-level supported financially or in-kind by the DSI. This section highlighted some of the key aspects and achievements of SA's international STI cooperation in support of the local and regional systems of innovation to give context to the more in-depth discussion to follow on SA-China Science Park Cooperation and strategic trilateral cooperation with regional partner countries.

### 3.3. STI collaboration with China

The DSI's ICR Programme drives an active portfolio of partnerships with China rooted in the S&T Cooperation Agreement signed in 1999 and the Five to Ten Year Strategic

Framework for Cooperation between SA and China: 2015-2024. Ongoing STI initiatives include more than 75 joint research projects and initiatives in relevant thematic areas, human capital development, the SA-China Young Scientist Exchange Programme and the recently launched SA-China Joint Research Centres Programme. In addition, in 2018, SA and China and the (then) DST and Chinese Ministry of Science and Technology (MOST), held various events to mark the SA-China 20 Year Celebration of Diplomatic Relations. In addition, as Chair of BRICS in 2018, SA hosted the 6th BRICS STI Ministerial Meeting and 10th BRICS Summit which was themed "BRICS in Africa: Collaboration for Inclusive Growth and Shared Prosperity in the 4IR" (DSI, 2019: 65).

These partnerships are also rooted in broader diplomatic relations between SA and China, which have resulted in the adoption of the Comprehensive Strategic Partnership Agreement signed in 2010, coordinated and monitored through the SA- China Bi-National Commission (BNC), and driven by several sectoral committees such as Economy and Trade; Minerals; Energy; and Foreign Affairs, Science and Technology (SAnews.gov.za, 2019). The Agreement's priorities include improving the structure of trade between the two countries by working towards a more balanced trade profile and encouraging trade in value-added manufactured products. A key objective in this regard would be Chinese enterprises investing in SA's manufacturing industry, as well as actively promoting the sourcing of value-added products by China from South African suppliers (SAnews.gov.za, 2019).

Beyond just research collaboration, therefore, a key emerging area in line with SA's increased focus on innovation is the Joint SA-China Science Park Cooperation through which the DSI seeks to attract investments to bolster capabilities and science infrastructure at local institutions and business incubators with a strong focus on innovation. The goal to attract Chinese investments is complemented by the DSI's drive to foster a comprehensive and deep understanding of the macro-level policy system supporting China's robust innovation system and proliferation of hi-tech industries in the country. As reflected in strategic Departmental discussions (in internal submissions, memos, and reports), investment opportunities being explored are through MOST and carefully facilitated by the Chinese Embassy in Pretoria which has a well-resourced S&T office. Some of the exploratory engagements are with Chinese technology giants such as Huawei, Alibaba, and Hisense as well as the government on the establishment of a

Joint Innovation Centre.

In line with these objectives, the DSI's participation in China's "Countries along the Belt and Road" initiative on Science Park and Business Incubator Planning, Construction and Administration since 2018 has presented a strategic opportunity to understand the cultural, policy, financing, and governance imperatives that have propelled China (in this particular case Shanghai) into the high-tech powerhouse it is widely held to be today. Yezi (2019: 1) summarises that Shanghai authorities have announced an intention to "transform the eastern Chinese city into a hub for science and technology innovation with a focus on integrated circuits, artificial intelligence and biomedicine along with other cutting-edge sectors". To achieve this, the government will strengthen resource integration, gathering together talent, and build a world-class industrial cluster.

Driven by the Shanghai Co-Way International Technology Transfer Centre with the support of MOST and Torch High Technology Industry Development Centre, the Belt and Road initiative has revealed crucial insights which will be discussed further below.

### 3.3.1. The Chinese way

It is important to contextualise the city of Shanghai's STI development within China's broader national objectives and priorities. China has declared a vision to build a modern, harmonious, and creative society in 2030 and continues to work tireless to realise its ambitious goal to become a global force in technology, and possibly even the leader again, by 2030 (World Bank, 2013: 190). Such a goal is in line with China's long-term objectives of becoming a leading economic, industrial, and military power, and therefore, reclaim its past scientific and technological glory (National Academies Press, 2010: 24). By 1978, China had started to lay the foundation by implementing economic reforms including the launch of the "open door policy" of 1978 which was a response to domestic crises and earlier invasion by Japan and Russia. Thus, these reforms represented efforts to modernise the country by "learning from the West" and narrowing the gap in economic development, technology, and military power between it and foreign powers (Huan, 1986: 2-3). Essentially, this saw China alter its development strategy from one based on self-sufficiency to one of active participation in the world market.

China's position as a state with a centrally planned economy with long-term plans is well

documented. Such a system has its challenges and is popularly scorned on the grounds of depriving citizens of their basic freedoms and human rights, and it also places certain limitations on China's innovation capability as China's rivals in the Organisation for Economic Cooperation and Development Development/ OECD (2008) note. The OECD further opines that "administrative interventions interfere with the normal functioning of markets, improper or even illegal conduct as well as some degree of local protectionism hamper or distort competition, and market institutions also remain underdeveloped and inadequate". The Chinese NSI, therefore, requires adaptation to the requirements of a market-based, innovative economy. However, the government's determination to bolster investment in S&T and build a full-fledged, high-performing national innovation system is demonstrated by policy initiatives such as the 2006-2020 Medium- to-Long-term Strategic Plan for the Development of S&T, which sets out the key objectives and priorities in S&T and principal ambition to make China an "innovation-oriented" society by the year 2020 and one of the world's leading "innovation economies", emphasising the need to develop capabilities for "indigenous" or "home-grown innovation" and build a high-performing "enterprise-based innovation system" (Wu *et al*, 2017; Wu, 2007; OECD, 2008: 41-43).

As such, despite its challenges, China's administrative system enables state efficiency to enact S&T policies and use its authority to align national culture with the needs for economic growth in S&T (The National Academies Press, 2010: 22-23). Culturally in the country, the pursuit of scientific and technological endeavours is considered a worthy ambition and an answer to societal and environmental problems; making scientists, engineers, academics, and entrepreneurs valued members of Chinese society, and economists and government leaders respected as technocrats (The National Academies Press, 2010: 40). The government largely addresses societal needs through detailed, industry- and sector-specific, well-financed S&T goals and strategies articulated in short-term five-year plans, 15-year Medium- to Long-Term Plans (MTLP), and ultimately against the S&T Roadmap to 2050.

In addition, it is well known that Chinese students begin learning subjects like Mathematics at a very early age. Wei (2014) explains that in China Maths textbooks begin with multiplication in the first semester of second grade when children are seven years old. He goes on that as a simple method to help children understand multiplication, they are taught to memorise the multiplication rhyme: "four times eight is 32, five times eight is

40" and so on, which was invented by ancient Chinese scholars 2,200 years ago. A long-standing culture of simplifying and appreciating a critical subject such as Mathematics is instilled in Chinese children from an early age.

Excellence in Maths at a very young age is a well-established culture in Chinese education, "because of China's standardised curriculum and teaching, the national exam system, and the one-child policy, teachers and parents in China have big expectations for their students from early on. There is a high degree of parental involvement and parents prioritise their children's education, especially in Maths (Wei, 2014). This section briefly demonstrated China's priority-setting, policy, and cultural commitment to the vision to become and re-assert itself as a global leader in technology and innovation by 2030. The section that follows will distill policy insights from the 2018 "Countries along the Belt and Road" initiative in Shanghai.

### 3.3.2. Building Shanghai into a world-class science city

The Chinese central government is driving a massive strategy to build Shanghai as a world-class science city and global innovation centre; with Zhanjiang (ZJ) town in the Pudong province as a Comprehensive S&T Centre, National Innovation Demonstration Zone, and Free Trade Pilot Zone. ZJ hosts an industrial park for high-tech companies. This is driven through very close relations between government, academia, and industry, wherein the government's major role is to provide policy direction and support; administrative guidance; as well as financial and technical investments.

The Shanghai Action Plan to Build S&T Key Areas with Global Impact, driven by the Municipality in extensive partnerships with private companies, multinational companies, and academia is underpinned by four key pillars: a) developing World-class R&D Facilities, b) Cluster of Technological Elements, c) Innovative Vitality, and d) Environment and Culture. The following details and observations were gleaned during an official visit to Shanghai, China, as a participant in the "Countries along the Belt and Road Workshop on Science Park and Business Incubator Planning, Construction and Administration" training programme from 8 to 23 December 2018 and are contained in that visit's approved report available at the DSI.

- World-class R&D Facilities: using prudent land planning, the government is

reserving land for leading R&D facilities and universities' R&D centres. In addition, it is actively attracting top R&D labs, renowned institutes, and universities to set up a presence in ZJ. This is to foster world frontier S&T to meet national needs and provide infrastructure for cutting-edge R&D activities, strengthening fundamental research, and making major breakthroughs for original research.

- Technological and industrial clustering: this is a strategy to place enterprises first to build a market-oriented and RDI-led technological innovation system; strengthening innovation support for SMEs, and undertaking industrial upgrading projects to form world-class high-tech industrial clusters. The three-pillar industries are IT, Lifesciences, and the Creative Industries; while Artificial Intelligence (AI), Aerospace, and Greentech form part of the fast-emerging industries.

- Innovative Vitality: aimed at cultivating a strong innovation culture and strengthen the creation, protection, and application of intellectual property rights, as well as developing a large number of strategic and S&T talents. This strategy has infused a dynamic environment in Shanghai characterised by a cohort of talented and highly skilled young people, diversified cutting edge incubators, institutional innovation and collaboration, strategic business investments supporting start-ups and linking them to established companies and multinationals, and sound Intellectual Property policies.

- Environment and Culture: a spread of Ecological Facility Projects and Urban Function Projects are being implemented to create a beautiful natural environment and build a diversified and dynamic space (completed urban function, convenient transportation, beautiful ecological environment, and rich cultural environment).

This is a broad overview of some of the key pillars on which China's policy to build a robust innovation system in which high-tech industries are anchored, even if its success is based on the RDI productivity of foreign companies in the country than necessarily Chinese enterprises. However, even at a glance, there are powerful lessons for consideration.

In support of the NDP vision, the White Paper on STI highlights several key policy issues

such as improved policy coherence; increased support for innovation; to revitalise key sectors, build an innovation culture, and brand SA as an innovative country; strengthening collaboration with business; and commercialisation of publicly-funded IP to name a few. All these are meant to strengthen the contribution of STI to the effort to address key socio-economic challenges. The White Paper also highlights the need to build efficiencies in international cooperation through, for instance, a systematised engagement framework; focusing on new funding instruments beyond the traditional academic research focus; and an intention to secure at least 15 % of SA GERD from international sources (DST, 2019: 59-60).

However, unlike in China, the landscape for agenda and priority setting, and policymaking in SA is fragmented as acknowledged in the 2019 White Paper on STI and is without clear long-term planning which leads to a lack of coherence and coordination within government and with key social partners such as academia, civil society, and the private sector. In addition, efforts to drive innovation across society and commercialising publicly-funded IP are quite ad-hoc and inadequate. Without an STI plan inextricably linked to the broader national industrial strategy and sector strategies, a lack of an international engagement strategy, and with departments, provinces, cities, companies, and organisations following their own scripts, it is hard to imagine.

This section of the chapter has reflected on the key policy, institutional and social considerations that emerge out of the SA-China Science Park Cooperation which remains a critical, yet new and budding, South-South STI partnership. The next section explores another example of South-South and pan-African solidarity, which leverages STI investments from the North to bolster the regional system of innovation.

### 3.4. STI Trilateral Cooperation with the US and Ireland

Although there is no universally accepted definition of trilateral cooperation, in the context of development cooperation it is understood to involve at least one provider of development cooperation or an international organisation and one or more providers of South-South cooperation (“pivotal countries”) to promote a sharing of knowledge and experience or implement development cooperation projects in one or more beneficiary countries (OECD, 2013: 13). What is distinct about this form of cooperation is that there is a donor country working in partnership with an emerging actor in development assistance

directed at a third country in need based on agreements (Zondi, 2015: 2). Typically, the providers of development cooperation are members of the OECD's Development Assistance Committee (OECD DAC).

Zondi (2015: 3) emphasises this point, stating this kind of engagement is often trilateral cooperation when a Northern party provides significant funding while the emerging donor from the South provides project management and technical expertise while also investing in the initiative. This funding is linked to the receiving country adhering to strict political conditionalities such as democracy, good governance, and human rights (Zondi, 2015: 3).

Of recent, OECD is emphasising that trilateral cooperation does not only include governments and international organisations but also civil society organisations, the private sector, philanthropy, sub-national actors, and academia. A common feature of this kind of cooperation is that know-how, skills, experiences, and resources from both developed and developing countries are combined. Although motivations behind trilateral cooperation may vary, primarily it is about joining forces to promote development in beneficiary countries, strengthening relations with Southern partners, and building the capacity of developing countries as providers of South-South cooperation (OECD, 2009: 5).

As demonstrated in successive annual reports of the DSI since 2010, there has been dynamic growth in STI-related development cooperation has between SA and the US largely driven by the Department and US Agency for International Development (USAID). Such partnerships are underpinned by the 1995 Bilateral Science and Technology Agreement between SA and the US. This Agreement has facilitated vibrant bilateral and development cooperation by way of R&D, HCD, and innovation support in broad areas such as energy, agriculture and water, environmental issues, health innovation, science education, and climate adaptability (SA DFA and US Department of State, 1995).

More recently, new forms of collaboration have been made possible with the establishment of the US Global Development Lab within USAID (USAID, 2016). According to USAID, being an innovation hub, the US Global Development Lab can take risks to test new ideas and partnerships to harness the power of innovative tools and

approaches that accelerate development impact. Through a partnership with the Lab, the DSI has leveraged two opportunities for the benefit of the NSI and regional science system, namely the Securing Water for Food (SWFF) Grand Challenge for Development and Partnership for Enhanced Engagement in Research (PEER) (USAID, 2016).

SWFF is a globally competitive programme that supports innovations with the highest potential, those that enable the production of more food with less water and/or make more water available for food production, processing, and distribution. It provides grant funds and acceleration assistance to support its business development. This partnership between USAID, Sweden through the Swedish International Development Cooperation Agency (Sida), the Government of SA through DSI, and the Ministry of Foreign Affairs of the Kingdom of the Netherlands has seen an investment of R496 million and provided critical acceleration support to promote such science and technology solutions across the developing world. PEER is a competitive awards Programme that facilitates collaboration on global development challenges between developing country scientists and researchers and their US counterparts who are funded by the National Science Foundation (NSF) and National Institute of Health (NIH).

The focus of this section, however, is on the traditional STI-related ODA cooperation between SA and the US. Various programmes have been implemented since 2009 benefitting the SA and regional NSI through a dedicated trilateral programme which saw just under R300 million in US investments to facilitate collaboration. Through the Mega Assistance Agreement between National Treasury and the US; aimed at strengthening the implementation of trilateral cooperation, the DSI since 2009 secured just under projects with USAID. As Departmental protocol, where possible, especially where there was strong alignment to national priorities, the DSI provided financial co-investment over and above in-kind investments.

Through the Trilateral Assistance Programme (TAP), USAID (2020: 1) states that it “supports SA as a leader in regional and continental contexts in a manner consistent with broader US government foreign policy objectives to promote peace and security to strengthen the SA government’s capacity to assist with African economic and social development and to respond to natural and security crises on the continent through training, exchange programmes and trilateral assistance funding”. To this end, USAID

supports various small-scale development projects on the continent, managed by the SA treasury and implemented by government departments and agencies.

The OECD regards trilateral cooperation as a highly relevant mechanism to implement the SDGs and governments and global development actors generally believe that trilateral cooperation and its results make aid more effective. This view could be linked to a desire to break away from the notion of traditional aid which has been blamed for perpetuating poverty and underdevelopment in the developing world; as a fundamentally flawed idea based on the logic of the colonial era's civilising mission premised on assumptions about the European man as a saviour of others (Zondi, 2015: 2). Shedding this sentiment is, however, not as simple as will be discussed in the reflections that follow The main objective of trilateral cooperation with the US is the use of research to address development issues across the SADC region and it led to some innovative responses in areas such as health innovation, climate risk management, agriculture, and food security challenges, capacity development, efforts towards commercialising African traditional medicines, etc.

According to internal Departmental reports these projects are the: 1) SADC IKS Policy Development and Regional Cooperation Workshop, 2) Climate Risk Capacity Building in the SADC region (Phases I and II), 3) Development and propagation of pathogen-free potato seed for yield improvement in Malawi, 4) Mozambique Marine Finfish Sea Cage Farming Project, 5) Assessing Human Health Risks and Coping Mechanisms to environmental pollution in two communities in the Lower Olifants River Catchment Area Phalaborwa and Massingir Dam in Mozambique, 6) Feasibility for the establishment of a SADC Virtual Research, Development and Innovation Network for Information Society, 7) IKS Standards Development and Capacity Building in SADC, 8) Trial to confirm the effectiveness of the microbicide 1% Tenofovir gel (FACT 001) awarded to SA by USAID and the Bill and Melinda Gates Foundation to confirm the CAPRISA 004 studies (DST, 2012 Deputy Minister speech at FACTS Annual Inaugural Workshop).

Similarly, in 2013 the DSI entered into an Agreement with Irish Aid for a three-year R1.6 million trilateral Ireland-DSI-Lesotho project, which was also rooted in the 2005 SA-Lesotho Bilateral Agreement on Science and Technology. The project "Improving Food Security through enhanced potato production and capacity development in Lesotho",

mainly aimed to sustain the process of disease-free potato culture production and develop human capital to sustain infrastructure and the application of certification standards for Lesotho. According to the 2013 Cooperation Agreement between the DST and Irish Aid, this was intended to contribute to food security and poverty reduction among smallholder farmers and communities through increased production of good quality and quantity of potatoes.

In addition, in line with Ireland's development cooperation programme to contribute to innovation, skills, and capacity development in SA and the region; the project was a value-addition to the first phase supported by the UK's Department for International Development (DFID) to improve the production of disease-free potatoes through capacity building of small-scale farmers in the Marakabei area (DST-Irish Aid, 2013). The project scope would cover the maintenance of the existing tissue culture facilities (laboratory and the greenhouse) at the National University of Lesotho, developing the capacity of the key players including the seed growers and farmers targeted for table production (DST and Irish Aid, 2013).

The DSI's engagements in trilateral cooperation in the region are guided by the existing portfolio of bilateral partnerships driven by the Department. This work seeks to reinforce broader continental strategies around STI such as the AU's STISA) 2024 and SADC industrialization strategy and roadmap 2015-2063. There is, therefore, a deliberate effort to integrate African continental and regional partnerships into broader international cooperation, not only to contribute to capacity building but also to reinforce and leverage SA's trade and investment partnerships and diplomatic relations.

The US-funded trilateral projects have ended and according to official project reports and joint DSI-US-implementing agency project evaluations available at the DSI, are regarded as successfully completed as good examples of trilateral cooperation which leveraged international resources, local systems, strengths, and capacities to answer pertinent scientific and development questions, augment research infrastructure and networks, and build STI capabilities. The OECD DAC and DSI are in engagements on a project planned for December 2019 to codify such learnings from the southern Africa experience to be shared with other regions.

On the other hand, the Ireland-SA-Lesotho potato project began well and later encountered a series of challenges that resulted in the Irish's official withdrawal of the investment and premature termination of the project. These related to poor national coordination and ownership which threatened the sustainability of the project. Based on engagements with the benefitting countries, Zondi (2015) highlights the capacity constraints with which the emerging development actor (in this case SA) incurs in these relationships, as they bear the responsibility to exercise "direct oversight over and continuous support to the project while also managing its relationship with the northern co-funder of the project" (Zondi, 2015: 4).

While sharing resources, benefits, and risks may make a good case for trilateral cooperation, Zondi (2015) points to key considerations to be made in the planning phase such as the inclusion of the views of beneficiary countries in the project design and management, taking stock of technical capacities, and keeping an eye out for values and attitudes inherent in development assistance. These are fundamental issues for the DSI to consider in engagements with North-South partners, whether funders or co-implementers while continuing to drive SA's science diplomacy agenda regionally and on the continent.

SA's ability to leverage strategic international STI partnerships to access funds, facilities, etc. to strengthen systems of innovation, enhance scientific and innovation capabilities and research infrastructure locally and in other countries in Africa, is a notable strength of the country's science diplomacy and compliments its support of SADC and AU objectives towards economic growth and development. The examples above, however, also demonstrate that if this is to be maximised, the DSI has to confront certain implicit assumptions and practices embedded in development assistance programmes which can undermine the good intentions.

### 3.5. Conclusion

This chapter has reflected on fundamental STI policy, institutional, and cultural issues emanating from the emerging SA-China Science Parks Cooperation and regional trilateral cooperation as examples of South-South cooperation and pan-Africanism. The lifted issues should inform SA science diplomacy if the vision and intentions of the NDP and White Paper on STI are to be realised within the prevailing fast-transforming global

and technological environment. Although relatively new, through cooperation with the Chinese government and multinationals, SA should position itself to leverage strategic skills and investments to build an innovation culture locally, strengthen academia-industry linkages, and implement science parks, enterprise incubators, etc. which form a key part of systemically harnessing an innovation-led society and enhancing economic competitiveness. The following Chapter 4 will reflect on SA science diplomacy through two strategic partnerships spanning the global North; strategic STI cooperation with the UK and Japan.

# CHAPTER 4

# ANALYSIS OF TWO STRATEGIC PARTNERSHIPS IN THE GLOBAL NORTH- THE UK AND JAPAN

## 4.1. Introduction

Chapter 2 defined the strategic focus of SA's STI cooperation and outlined its four main objectives, namely to access international funds to complement SA's national investments in STI; to enhance national STI capabilities through access to international knowledge capacities and resources; to strengthen cooperation in STI in Africa to build capacities and support initiatives of SADC and AU for the advancement of national and Africa's growth and development agenda, and to maximise SA's strategic interests in international cooperation in STI support of foreign policy objectives and international trade and investment partnerships. Chapter three discussed the third and fourth objectives as key modalities for implementing science diplomacy in the form of a strategic partnership with China as a key global South actor and trilateral cooperation on Lesotho as a form of North-South relations in science diplomacy.

This chapter explores two case studies representing strategic partnerships with the global North, being STI cooperation with the UK and Japan within a rapidly transforming 4IR context that has made innovation ever more in demand. The chapter will discuss the salient cultural, policy, institutional, and governance drivers of STI cooperation that have proved effective in the contexts explored as examples of how science diplomacy has practically been advanced.

## 4.2. STI cooperation with the UK

SA's STI relationship with the UK is rooted in the 1995 Bilateral Science and Technology Agreement, which facilitated academic and scientific research collaborations on priority focus areas such as health research; astronomy and space; biosciences; and climate change (UK Science and Innovation Network, 2019). In addition, discipline and interdisciplinary research collaborations have been bolstered by the UK's

Global Challenges Research Fund (GCRF)- a GBP 1.5 billion fund established in 2015 to support cutting-edge research to address challenges faced by developing countries as part of the UK's ODA (GCRF, 2020). Under this scheme, the Newton Fund is SA's primary bilateral partnership with the UK, giving rise to the UK-SA Newton Fund Agreement signed in 2014. In terms of thematic focus, Newton Fund activities are in three broad areas: public health; environment and food security; and science and technology capacity building, underpinned by crosscutting themes of Big Data and regional cooperation across Africa (British High Commission, DST, 2018: 4). SA has particularly been keen to explore how the Newton Fund can work in multilateral settings such as through the SADC, the AU, and BRICS (British High Commission, DST, 2018:4).

This remains a key strategic priority in the Department's international engagements as highlighted by then-Minister, Ms. Mmamoloko Kubayi-Ngubane, in the DST's 2018 Budget Vote when she remarked, "Beyond our own continent, we will work to further expand collaboration with partners in the Global South, especially within the Brazil, Russia, India, China, and South Africa (BRICS) framework. Under South Africa's BRICS Presidency, the Department will lead several initiatives to bolster BRICS cooperation, especially in disruptive technologies and big data, to give BRICS partners a competitive advantage in the Fourth Industrial Revolution" (DST Budget Vote, 2018).

In addition, highly active collaboration with the UK is facilitated through the EU competitive grant Framework Programme Horizon 2020, which has made available about EURO 80 billion (over R1.3 trillion) of funding over seven years (2014-2020) to facilitate challenge-based research and innovation in Europe and through collaboration with international partners (EU, 2020: 1). SA is the fifth most successful country in accessing Horizon 2020 funding, partnering in these with the UK more than any other country (UK Science and Innovation, 2019). Horizon 2020 has a strong focus on SMEs and three key areas: excellent science, industrial leadership, and societal challenges. SA's participation has also typically included another African country. Such kind of access by SA and Africa to global capacity and resources results in increased knowledge generation, research infrastructure investments, human capital development, innovation partnerships, and greater coordination and synergy of the NSI.

As mentioned SA's primary bilateral partnership with the UK is under the UK-SA Newton

Fund, which is a GBP 8 million (over R151 million) Fund per year from 2014 to 2021. Through this fund, the UK government aims to strengthen the science and innovation capacity of 15 selected partner countries including South Africa for economic and social development (British High Commission, 2015: 5). This is through a match funding arrangement between participating governments and the UK, wherein the participating governments make a co-investment to match the UK funding. The Newton Fund focuses on three broad topics, namely people (capacity building), research (research collaborations on development topics), and translation (innovation partnerships and challenge funds to develop innovative solutions on development topics) and is delivered through research calls, fellowships, research chairs, mobility schemes, joint research programmes, and activities focussing on science and technology capacity building, public health, environment, and food security, with the ultimate aim of encouraging research and innovation that boosts jobs and growth (British High Commission, 2015: 7).

As part of this partnership, for instance, the UK and SA MRCs have committed to joint research programmes on improved prevention, detection, and control of tuberculosis (TB) and on research on non-communicable diseases such as diabetes, hypertension, and cancer (British High Commission, 2015: 9). The MRCs have jointly pledged up to GBP 9 million (R170 484 000) for these collaborations. Other examples include the SA-UK Research Chairs Programme launched in 2017 as part of an effort to expand the SA Research Chairs Initiative (SARChI) through collaborative partnership. Three bilateral research chairs have been awarded in political theory, social protection for food security and ocean science and marine food security; and two trilateral chairs have been awarded in transformative innovation, the 4IR, and sustainable development; and mainstreaming gender for energy security in poor urban environments (Fishing Industry News SA/FINSA, 2019).

There are many other examples of collaboration under the UK-SA Newton Fund Programme, however, these few illustrate the significant investments and myriad of activities contributing to SA's participation in global knowledge platforms, building capabilities, the utilisation of knowledge, and innovation for economic and inclusive development. It should be noted that in these partnerships the DSI strives to ensure that particular attention is paid to historically disadvantaged institutions and groups including black Africans, women, and young people as beneficiaries (DSI, 2020a).

Lastly, a flagship of the bilateral relationship is in radio astronomy- the Square Kilometre Array (SKA), a significant global radio telescope project to be mainly built in SA and partly in Australia (skatelescope.org, 2020). The UK is a key player in the SKA and hosts the global headquarters in Manchester. In June 2020 SA, became the third country, after the Netherlands and Italy, to ratify the Convention Establishing the SKA partners could continue doing more observations and analysing the data generated (ANV newsletter, 2017: 5). The SA DIRCO funded a large part of the conversion project through the African Renaissance and International Cooperation Fund (ARF), whose aim then-Minister, Ms. Maite Nkoana-Mashabane explained as, “strengthening cooperation between South Africa and other African countries and to support the development of skills and build institutional capacity on the continent (AVN Newsletter, 2017:5).

Not only is participation in the SKA the surest signal yet of SA’s ambition to place herself at the core of the global knowledge economy and be recognised as a “producer” and exporter of knowledge as referred to by Masters (2016), but it also serves two other purposes: it is a global knowledge platform where SA can advance its strategic interests. Secondly, it secures SA’s position as an STI leader on the continent of Africa. Critically for SA society, the project is attracting investments into STI infrastructure development and local technology companies, developing the next generation of scientists, and creating employment opportunities for local communities in the Northern Cape (NRF 2019).

To date over R300 million has been spent in the Northern Cape on the construction of the KAT-7, a proof-of-concept radio telescope, and MeerKAT, the precursor to the SKA (NRF, 2019). In addition, under the UK-Newton Fund, the Radio Astronomy for Development in Africa Programme has seen up to GBP 1 million (R18 933 800) of joint funding through the UK's Science and Technology Facilities Council (STFC), the NRF, and SKA SA Office have developed a new research programme in the area of Astronomy in Africa centred on the African Very Long Baseline Interferometry Network (AVN) which Minister of Higher Education, Science and Innovation, Dr. Blade Nzimande, explained in his 2020 Budget Vote Speech, “aims to establish self-sufficient radio telescopes in Africa through the conversion of redundant telecommunications antennae into radio telescopes, "new-build" telescopes or training facilities with training telescope. Other countries who

participate in this initiative are Botswana, Ghana, Kenya, Madagascar, Mauritius, Mozambique, Namibia, and Zambia".

Underscoring its relevance, Dr. Pandor, then-Minister in 2017 remarked that, "a vital part of the effort towards building SKA on the African continent over the next decade is to develop the skills, regulations and institutional capacity needed in SKA partner countries to optimise African participation in the SKA". The ANV, thus, exemplifies SA's role as a "consumer" or importer of knowledge in leveraging a global science project, the SKA, to meet domestic and or regional priorities (Masters, 2016).

As demonstrated by the SA-UK bilateral relationship, through science diplomacy the DSI has secured some notable achievements as described above in line with national priorities, especially in building research infrastructure and strategically relevant STI capabilities for the country and parts of the continent. For instance, young scientists are funded to pursue post-graduate studies and of the 1054 students who have received study grants, 802 are from SA, 176 are from the other SKA African partner countries, and 76 are from other countries (NRF, 2019). In addition, in preparation for the second-phase construction of the SKA, in 2017 Ghana became the first of SA's eight African SKA partner countries to complete the conversion of a communications antenna into a functioning radio telescope (DST, Budget Vote Speech: 2018).

This meant the instrument could operate as a single-dish radio telescope and also as part of global VLBI network observations, such as the European VLBI network, and allowed the research teams from Ghana and SA and other international research partners could continue doing more observations and analysing the data generated (ANV newsletter, 2017: 5). The SA DIRCO funded a large part of the conversion project through the African Renaissance and International Cooperation Fund (ARF), whose aim then-Minister, Ms. Maite Nkoana-Mashabane explained as, "strengthening cooperation between South Africa and other African countries and to support the development of skills and build institutional capacity on the continent (AVN Newsletter, 2017: 5).

Another achievement is cooperation for knowledge generation as seen by the myriad of collaborations, which will contribute to an increase in the number and quality of international publications co-authored by SA scholars. The DSI (2019) highlights that the

SA-UK Research Chairs and the two Trilateral Chairs described previously are aimed at improving the extent, delivery, and impact of research capacity and providing mentorship opportunities for young emerging researchers at SA universities. Through the Programme lives are being improved through health research, young innovators are being supported to commercialise their ideas, and hundreds of early-stage researchers are strengthening their work through international collaboration (DSI Media Advisory, 2019).

In addition, according to the NRF (2020), by late 2020 five SA projects were part of 27 research and innovation projects shortlisted under the Newton Prize 2020, which celebrates outstanding international research partnerships that play an important role in addressing challenges in developing countries and around the world e.g. tackling water pollution, producing clean energy, HIV prevention, the protection of historical sites, as well as the current COVID-19 pandemic (NRF Press Release, 2020). The five are “Food insecurity in the Western Indian Ocean- an impending humanitarian crisis driven by a warming ocean”; “The roles of plasma levels and genetics of haemostatic factors in cardiovascular disease development in Africans”; “An epidemic in retreat? Establishing the population impact of combination prevention strategies in a resource-poor, hyper-endemic rural African population”; “Training and knowledge exchange in early Bantu language development assessment”; and “Social Protection for Food Security in South Africa”. The SA lead researchers are from Nelson Mandela University, North-West University, Nelson Mandela Medical School, University of Cape Town, and the University of the Western Cape respectively.

In addition, playing a central role in a major global project like the SKA and participating in prestigious global knowledge networks positions SA quite strategically as a contributor to global issues and beneficiary of international investments (DSI, 2019). While the project has substantial global significance in terms of astronomy, science, and technology development and spin-offs for the local and regional economy as previously elaborated, it is also accompanied by negative socio-economic implications which are mostly as a result of insufficient consultation and collaboration between the local communities, municipal representatives, provincial representatives and the SKA (Atkinson *et al,* 2017: 95-97).

In the Socio-economic Assessment on SKA Phase 1 in SA, these authors identified two important conflict issues, namely conflict around land acquisition and servitudes and conflict around the social and economic impact of the SKA on local stakeholders. Among others, key concerns include a reduction in the amount of land available to sheep-farming due to the acquisition of land for the SKA; loss of farm workers' jobs on the acquired farms and possible increase of unemployment in the agricultural sector; lack of social development in the local towns due to insufficient participation and involvement by key stakeholder departments; disturbance of lifestyle and social unrest due to restrictions prescribed by the Astronomy Geographic Advantage (AGA) draft regulations on existing modern telecommunication devices and services in the region, etc.(Atkinson*etal*,2017:96-97).

Further, on the science front, the project's big data presents both opportunities and challenges in terms of participation in novel international science cooperation and having to balance that with science communication to promote important research results and popularise science and technological knowledge, etc. in ways that are acceptable to the general public (An, 2019:5). Meanwhile, the transportation, storage, reading, writing, computation, curation, and archiving of the SKA-level data and the release of SKA science products are posing serious challenges to the field of ICT (An, 2019: 1).

Notwithstanding the achievements and challenges highlighted, it is generally held that the SA NSI could function more optimally and generate systemic gains for society if several key constraints to be discussed in this Chapter could be addressed (DST, 2019: i). NACI publishes annually the Science, Technology, and Innovation Indicators (STII) report, which provides an analysis of the state of STI in SA and includes indicators that are critical in the monitoring and evaluation of the NSI and its impact and/or contribution towards achieving the country's set national objectives (NACI, 2019: 12). The reports explore six broad categories, namely research and development (R&D) expenditure, STI human capital, STI funding and support, scientific publications and patents, innovation and entrepreneurship, and innovation for inclusiveness and social impact.

The 2019 STII report tells a story of progress for the last 26 years such as expanding the NSI and introducing new purpose-driven institutions such as TIA, SANSA, NIPMO, etc.; government expenditure of research and development (R&D); enhanced STI human

capital through formal qualifications with an increase in the number of doctoral graduates from 26.6 per million of the population in 2007 to 53.9 per million of the population in 2017; an increase in high-quality scientific publications growing at an annual rate of 7% from 192 per million people in 2008 to 350 in 2017 and increased participation of women and black people; and growing uptake of STI, entrepreneurship, and grassroots innovation. These are critical enablers for innovation performance.

However, the report also points to significant structural challenges that remain in the NSI. SA has struggled for years to reach the target, the White Paper on STI recommits SA to increasing government expenditure on research and development (GERD) from 0.7% to 1.5% over the next decade, which would be on par with the global average (the OECD average is 2.4%). In 2017/18 GERD amounted to R38,725 billion translating to a nominal 8,5 percent increase over the R35,693 billion in 2016/17 and representing 0.8% of the GDP (Centre for Science, Technology and Innovation Indicators, 2019: 15).

The underachievement of desired GERD is an enduring concern as noted by then Minister of Science and Technology, Naledi Pandor, in the DST's 2015/16 Budget Vote that "Our budget for 2015/16 increases modestly to R7.4 billion. Although we are working closely with colleagues in Treasury to map out a process for ensuring we reach the ANC Manifesto target of 1, 5% of Gross Domestic Product (GDP) by 2019, I remain concerned that inadequate resources for research and innovation will deny us the opportunity to realise the full potential of the difference science and innovation can make in a society." Pandor further asserts that, while government restraints on public expenditure are understandable, investment in research and innovation can and will lead to greater prosperity, more jobs, and more entrepreneurs (DST, 2015: 1).

According to NACI (2019), 57% of the overall GERD in 2018 was provided by the public sector, with the private sector and foreign sources providing the balance, and GERD for the higher education sector was on the increase having risen from 45% in 2010/11 to 56.1% in 2016/17 while business expenditure on R&D (BERD) dropped from 9.6% in 2008/9 to 2.8% in 2016/17. It should be noted that these figures were influenced by a challenging economic environment. However, it also has to be noted that the shortfall on GERD is a lingering SA challenge with stagnant funding that is uncoordinated (White Paper, 2019: 23).

In contrast, according to Rhodes *et al* (2020), the total expenditure on R&D in the UK was GBP 37.1 billion in 2018, the equivalent of 1.7% of GDP, and has been rising steadily over the past few decades from GBP 18.5 billion in 1981. In addition, the business sector is the largest funder of R&D performed in the UK, having funded GBP 20.3 billion (55%) of R&D with public funding for R&D accounting for 26% of the total at GBP 9.6 billion invested in 2018. The business sector also performed the largest R&D worth GBP 25.0 billion in 2017, 68% of the total, and the public sector performing 30%, worth GBP 11.2 billion. Further, the UK has a target of 2.4% GERD by 2027, with the private sector traditionally being the largest funder unlike in SA whereas it is state-led.

Such a positive scenario can be attributed to the success of the UK's highly developed economy and an STI system that enjoys a good level of funding and participation by multinational companies. It is also an illustration that, although promoting R&D in domestic firms and manufacturing industries is also a challenge for the UK, the various government support measures to increase innovation in companies and support SMEs are succeeding. These include a large R&D tax credits programme open to any company in any sector liable to pay corporation tax, an R&D Allowance which gives 100% relief for capital expenditures on R&D, and the Patent Box scheme introduced to provide an additional corporate tax incentive for companies to retain and commercialise existing patents on products derived from UK and EU patents (OECD, 2016: 56). On the other hand, while SA also has an R&D Tax Incentive programme administered online by a Directorate in the DSI, it is reportedly fraught with capacity constraints, technical glitches, and inefficiencies leading to frustrated innovators and limited applications to the programme (Ho, 2020).

Another challenge facing SA is related to incomplete transformation, infrastructure backlogs, and an insufficient research focus. This manifests in the country's serious skills shortage, especially high-end skills; low rate of production of research students; under-representation of black and female SA students in research degrees and careers; relatively low number of active and productive R&D workers and training activities linked to technological innovation; and low levels of support and coordination of productive partnerships between universities, research councils, the private sector, and across different government departments (NACI, 2017: 16). Although improving, the production

rate of PhDs remains lower than the NDP target of 100 per million by 2030 (DSI, 2019: 60).

It is also interesting to note that in terms of research areas, the highest activity indices are in respect of infectious diseases, religion, astronomy and astrophysics, and plant sciences; where SA appears to perform almost five times more research on infectious diseases than is expected by the total research undertaken in the system and the worldwide average (NACI, 2019: 44). In contrast, the disciplines that mainly support 4IR such as computer science, chemistry, engineering, and materials science have low activity indices. A positive score on 4IR - related research is that SA has the highest world share of scientific publications in artificial intelligence at 1.01% and the Internet of Things at 0.68% (NACI, 2019: 11).

Concerning patents, SA also lags behind the average patent applications per million inhabitants for upper-middle-income countries with 42 patents in 2008 and 37 in 2017, while the global average is 592 (NACI, 2019: 16). Patents are a critical indicator of national and corporate inventive activity and in the same way that scientific articles are accepted as a legitimate reflection of scientific research, patents are accepted as a reflection of technological achievements (NACI, 2019: 52). The fact that the production of SA patents is declining is concerning and points to a need to create more public awareness and seriously reflect on the intellectual property (IP) regime and interventions such as NIPMO which are supposed to encourage IP protection and commercialisation by providing various incentives.

The OECD (2007) cites as the root cause of SA's poor transformation performance and limited human capital, the country's failing public education system with poor quality education the norm for the majority of people; human resource shortages at all levels in mathematics, science, and technology; aging, white, male dominance of industrial and academic R&D; a lack of design, engineering, entrepreneurial and management actors (DEEM) and R&D capacity leading to an "engineering gap"; a large "second economy" with insufficient entrepreneurial and technological skills; and inconsistencies between immigration policies and the human resource needs of the innovation system. Generally, the SA public schooling system does not encourage a culture of innovation and the innovation funding environment is also not conductive as funders are generally risk-

averse to early-stage innovations (NACI, 2017: 16).

As a result, SA has lost its competitive advantage in terms of medium-technology exports when compared to the average of other upper-middle-income countries, having dropped from 44th to 67th position on the Global Competitiveness Index between 2007 and 2017, and from 38th to 58th position on the Global Innovation Index at the same time (NACI, 2019: 11). It was expected that by 2020, SA would likely rank below the lower-middle-income countries in terms of the export of low-technology products which indicates regression to a resource-based economy and contradicts the envisaged plan to become a knowledge-based economy (NACI, 2019: 10). In addition, SA ranks low in several indicators on social progress and human development indices.

On the other hand, the UK boasts a robust culture of innovation which sees it sit very high in successive global innovation rankings, for instance, ranked 9th in the 2019 Global Competitiveness Index and 5th in the Global Innovation Index at the same time. It is worth pointing out that the UK innovation system also faces key challenges such as the inadequate adoption of innovation by organisations, technology transfer, and commercialisation when compared to other countries at similar levels of economic development, and R&D in local firms as alluded to previously (OECD, 2016: 56-57). These constraints are mainly attributed to poor organisational culture, a lack of education in certain instances, and departments working in silos leading to poor industry-science linkages (Raconteur, 2016).

On the whole, however, the UK boasts an excellent STI balance sheet due to holistic long-term planning, which links its industrial strategy to key productivity-sector policies and programmes and investments. This is of course historical as the UK has been in had centuries of a head-start and has not suffered any limitations and shortage of investment. In addition, the UK's education system has a long history of positive outcomes as a result of investments in infrastructure, assessments, and evaluation systems that nurture critical talent and skills for a knowledge-based society at an early age. According to the OECD (2016), for instance, by the age of 15 years students in the UK perform above the OECD average in reading, science, mathematics, and collaborative problem-solving. In addition, boys and girls are equally likely to score at Level 5 or 6- the highest levels of proficiency- in science and are equally likely to expect to work in a science-related

occupation at age 30.

The UK has also fared well in key innovation performance indicators targeted at higher education such as raising the quality of science (institutional and international scientific collaboration and knowledge flows), promoting excellence (partnerships with leading experts leading to excellence and highly-cited publications), investing in scientists and engineers, and facilitating student exchanges and researcher mobility (supporting dynamic international mobility) (OECD, 2016: 12-17). Two other key pillars in the strategy to boost innovation at the R&D level are, firstly a strong focus on innovation for global challenges where long-term, higher-risk research leads to the development of frontier technologies and data-driven applications that are needed to help tackle global challenges (climate change, aging societies, food security), productivity growth (manufacturing processes), and environmental and social STI policy (OECD, 2016: 9). In this regard, the UK is focused on developing a low-carbon economy through, among others, the flagship GBP 1.5 billion Global Challenges Research Fund which is to be spent over the 2016/17 to 2020/21 period; targeting areas where multidisciplinary research is required to address new and emerging social, environmental and health challenges throughout the world and can complement targeted investment in clean energy (OECD, 2016: 56). This includes developing technologies and applications.

Secondly, international partnerships in RDI are fashioned in ways that will ensure the UK remains a world leader in emerging technologies, particularly medical technologies, smart mobility and logistics; advanced manufacturing; and AI and Quantum Computing (Bhopal, 2019).

In terms of bridging the industry-science gap, the UK government's business-targeting incentives discussed earlier are making inroads, as well as key programmes promoting collaboration in innovation among firms, supporting business innovation, entrepreneurship, and empowering society with S&T. Interventions such as the Knowledge Transfer Network (KTN) assist to stimulate innovation through knowledge transfer, and Innovate UK- the government's innovation agency- works with individuals, companies and other organisations to fuel new S&T innovations that boost productivity, create jobs and help to increase UK exports (Raconteur, 2016).

These trends are set to continue under the latest iteration of the UK's long-term Industrial Strategy launched in 2017, which identifies five pillars of success, namely:

- ideas: raising total R&D investment to 2.4% of GDP by 2027 and investing GBP 725 million in new Industrial Strategy Challenge Fund programmes to capture the value of innovation;
- people: establishing a world-leading technical education system, investing GBP 406 million in maths, digital and technical education to help address the shortage in STEM skills, and create a new National Retraining Scheme;
- infrastructure: increasing the National Productivity Investment Fund to GBP 31 billion, supporting electric vehicles through GBP 400 million for charging infrastructure, and providing over GBP 1 billion to boost digital infrastructure, including GBP 176 million for 5G;
- business environment**:** launching Sector Deals for life sciences, construction, AI, and the automotive sector to boost productivity, drive over GBP 20 billion of investment in innovation and high potential business, and launch a review of how to best support the growth of SME; and
- places: reaching consensus on Local Industrial Strategies, creating a GBP 1.7 billion Transforming Cities Fund to improve intra-city transport and provide GBP 42 million to pilot a Teacher Development Premium as an integrated programme to recruit and retain more teachers in schools (Bhopal,2019).

The third broad challenge in SA's innovation system relates to the lack of an all-encompassing, coherent innovation policy or network alignment (Petersen, Kruss; 2019: 351). This refers to the idea that innovation policy should be aligned with the goals and strategies of government departments responsible for promoting inclusive development. However, their analysis of the SA NSI suggests that while policy worldviews and goals may be shared at the highest level, when it comes to strategies, programmes and instruments, there are significant differences between government departments and they argue that orienting the NSI more effectively to 'increase well-being and expand prosperity for all...' (DST, 2016: 1) would require a different policy worldview and set of policy goals and instruments, and involves a wider set of actors and processes (Petersen, Kruss; 2019: 366).

This is acknowledged in the White Paper on STI with SA innovation described as mostly

flat. Until the review and subsequent adoption of the new White Paper in 2019, SA's STI policy landscape was grounded on the White Paper on Science and Technology, the 2002 National Research and Development Strategy, and the Ten-year Innovation Plan for SA (2008– 2018), as well as various sectoral and cross-cutting STI strategies adopted for strategic areas e.g. advanced manufacturing technology, biotechnology, and human resource development. The implementation of the White Paper on STI will be directed through successive decadal plans, which will be informed by analysis, foresight, and government's priority outcomes as captured in the NDP and the Medium-term Strategic Framework (MTSF) (DSI, 2019: 28).

Although the policy and frameworks are framed and presented as being for all government and social actors, they are in reality not owned as such. They are seen as government documents or even DSI documents that do not find strong resonance elsewhere. As a result, and linked to other issues to be discussed below, SA's innovation policy landscape has proved problematic in at least three ways. Firstly, the dominant understanding of the local NSI is overly focused on the role of the state. According to the OECD (2007) the practical details on the SA NSI have been often mapped out in ways that are narrow, with too much focus on the role of public R&D- performing institutions and less emphasis on the central role of business enterprises in generating and implementing innovation; and the importance of enterprises, and not only education and training organisations, in creating scientific and technological human resources for innovation to name a few.

Generally, collaboration with business and civil society is weak and developing and or strengthening it is an explicit policy intent in the White Paper and has featured in the DSI's ICR Annual Performance Plan for many years. The intention is partly to establish and leverage mutually beneficial partnerships with Foundations, Philanthropic Organisations, and Corporate Social Investment (CSI) divisions of local companies, while also strategically positioning STI in SA's broader international trade and investment agenda. This strand of SA's science diplomacy is quite weak and this may be attributed to several reasons to be discussed below.

Secondly, the lack of policy coherence (the "silo mentality") remains one of SA's biggest challenges which impedes the state's ability to make societal impact and influence

knowledge-based policymaking. The White Paper, for instance, introduces the "whole of government and society" approach to policymaking, which underscores the need for alignment and coordination across sectors. However, in the same breath proposes as a solution the establishment of formal structures such as a Ministerial STI Structure and STI Plenary comprising government, business, academia, and civil society, to be convened by the Presidency.

The fragmented nature of SA's public administration renders such structures ineffective in bringing about coherence and joint priority-setting when it comes to departments developing their annual plans and budgets and at the implementation level. These high-level forums may succeed in serving other purposes but as a tool for implementing change and results, they have not proved effective. On the coherent implementation of a national IID strategy, for instance, Kruss *et al* (2017) make three concrete proposals on how the DSI can facilitate alignment and coordination across national policy, namely to a) coordinate across key departments to extend, deepen and align the focus of existing policy instruments to integrate innovation goals where they are missing or promote socioeconomic inclusion goals where the emphasis is solely on formal innovation goals, b) design new policy instruments that will be required to address significant gaps in existing instruments to promote new priorities, and c) facilitate the formation of effective implementation networks.

In addition, when it comes to processes to make priorities, selection and achieving critical scale, there are indications that decisions in SA are commonly made in ways that result in stretching resources too thin over too many activities across various fields of the STI system (OECD, 2007: 17). For example, a) across activities in individual fields of STI; b) across activities in individual organisations; c) across portfolios of major national projects and centres; and d) across major initiatives to facilitate the emergence of sectoral innovation systems which all together limits the ability of individual activities to reach the scale and critical mass needed to achieve intended aims (OECD, 2007: 17).

Thirdly, the OECD (2007) notes that in SA processes that should hold together the connection between strategies and their implementation are flawed as there appears to be too little connection between the articulation of important technological and innovation priorities and their subsequent implementation. A glaring recent example is social and

economic infrastructure development, where the government has since 2018 announced plans without much transparency and detail on the implementation and monitoring mechanisms while the lived experiences of SA are of frequent load-shedding of electricity, expensive data, and lack of connectivity, a lack of clean water and sanitation, poor public-school infrastructure as generally reported in news media. For STI policy, specifically, this is aggravated by a lack of a strong cross-departmental body at the cabinet level responsible for holistic oversight of the departmental strands of innovation system policy. This could crucially monitor the cross-system effects of planned departmental initiatives that pose demands on available human resources and foster cross-departmental integration in areas of interface (OECD, 2007: 19).

This role is supposed to be played by NACI, however, it appears to interact mainly with the DSI as its accounting department. The UK sought to resolve this by establishing a new single non-departmental public body- the UK Research and Innovation (UKRI) – which brings together the UK's seven Research Councils and Innovate UK and operates at arm's length from the government (OECD, 2016: 56). The UKRI's primary focus is on cross-cutting issues and improved collaboration between the research base and the commercialisation of discoveries in the business community. There are lessons to be learned from this approach.

The fourth broad set of challenges in SA, somewhat related to some of the issues discussed above, are weak governance, a fragmented NSI, and a lack of systemic monitoring evaluation (M&E). It is always important to start by highlighting that SA's STI system and its performance- like all other sectors of society- are reflective of the progress and lingering constraints linked to how transformation is evolving in the country. The weak governance arrangements of the STI system can be attributed to three main structural issues that are comprehensively articulated by the OECD (2007, 18-19) but can only be presented in brief here, like organisational structure- vertical specialisation and differentiation, horizontal integration and coordination, and linking national to provincial and local levels.

The vertical structure of roles and organisations responsible for the governance of the innovation system in SA incorporates less specialisation and differentiation than common practice among OECD countries, and leads to confusion and duplication of

responsibilities, for instance, between the NRF and science councils. In terms of horizontal integration and coordination, horizontal dimensions of the governance structure also incorporate less integration than is common practice in many OECD countries. SA lacks a holistic approach to innovation policy which calls for greater cross-cutting coherence (OECD, 2077: 18).

Although there is well-established "informal" interaction between different agencies responsible for public funding of R&D and other innovation support activities, and strong cooperative interaction between departments with an STI policy role, questions of role-clarification and a more effective interface and perhaps greater integration remain. For instance, a systematic interface between the NRF and TIA could enhance the link between publicly-funded research and commercialisation. In addition, most departments only interface with the DSI at the clusters of Forum of SA Directors-General (FOSAD) which is supposed to foster cross-departmental integration but beyond reporting purposes, in practice that integration depends on the shrewdness and will of individual DGs or DDGs to make and drive linkages. Furthermore, owing to their complementary roles in respect of education and training, research, and innovation support, greater integration is required between the DSI, and Departments of Education, Higher Education, Labour, and Trade and Industry (OECD, 2007: 18-19).

The third organisational structure challenge relates to linking national to provincial and local levels as there appears to be fairly weak integration between national policy and organisations and innovation-related policy and support measures at the provincial and local levels (OECD, 2007: 19). There is, for instance, a single national DSI and no provincial departments although there is a network of DSI entities such as the NRF and CSIR in some provinces. Such weak integration between national STI policy and provincial/local support measures has the effect of undercutting the potential of STI to make an impact at the grassroots level.

It would of course be unfair to attribute this set of vexing constraints to a failure of SA science diplomacy. Instead, they are a result of a confluence of enduring, systemic challenges linked to apartheid and modern failures by the government of the day. Specifically, on international a major problem is the absence of a clear, integrated science diplomacy framework that sets a national vision, aspirations, priority areas, timeframes,

potential partners, etc., and locates key players within and outside government and their envisaged contribution. This would not serve to centralise science diplomacy to the DSI, for instance, but act as an overarching national guide to the rest of the NSI and maximise efforts and resources. At the moment the conduct of science diplomacy is chaotic and limits the potential for scale and impact.

In addition, at the moment there is no formal process to meaningfully synergise the work of the DSI and Department of Trade and Industry particularly on engaging the business sector. It may be that there just aren't adequate capacities or capabilities yet in the public service to realise these ambitions. There are lessons to be learned from the UK system for it represents a concerted attempt at long-term cross-governmental strategies linked to the industrial strategy, generating resources to support R&D, investments in human capital development and globalisation of R&D, building key infrastructure, creating institutions that are fit for purpose, incentives for business R&D, productive partnerships with business particularly attracting massive R&D investments from multinational corporations, and deliberate international cooperation strategy, etc. Governance is also enhanced by the UK's attention to evaluations and reviews focused on specific aspects of the STI system, providing the stimulus for significant structural changes in the governance and management, as well as the focus of public investment in STI, increasing analytical capability and ensuring independent and transparent quality assurance, (OECD, 2016: 56).

The UK has- through its bilateral relations with SA- made available this expertise via partnership opportunities. Policy programmes such as the Global Innovation Policy Accelerator (GIPA) and Transformative Innovation Policy Consortium (TIPC) driven by the UK's National Endowment for Science, Technology and the Arts (NESTA) and Science Policy Research Unit (SPRU) provide opportunities for cross-pollination of experience, exchange of knowledge and transfer of lessons. It is not possible to get into the details of these programmes here due to limited space, save to say they generally offer training in holistic, design-led policy making and implementation and experimentation with innovation methods for systemic change (Science Policy Research Unit, 2019; NESTA, 2019).

Some of these lessons and cross-pollination seem to have influenced the rethinking of

the innovation approach that appears in the White Paper. In line with the White Paper's ethos on the adoption of a whole-of-society approach to innovation, the DSI is using programmes like the GIPA, TIPC, and the Mission-Oriented Innovation Network, among others, to build the policy skills and capabilities that the system will require to deliver on innovation. They are only being piloted by a small group lead by the DSI, however, it is hoped such initiatives will not only help build individual capabilities of officials but also enable the Department to draw in innovation champions from the rest of government and society and thus enhance policy coherence and programme coordination across the NSI. The challenge will be in how well South Africa translates this whole-of-society approach into widespread practice, something future studies must attempt to analyse.

### 4.3. S&T Cooperation with Japan

#### 4.3.1. The context:

SA's STI relationship with Japan is grounded on the Agreement for Scientific and Technological Cooperation signed by the two governments in 2003 to facilitate research cooperation and exchange of capacities, expertise, and technology (Department of Arts, Culture, Science and Technology; 2003: 2). The areas of research cooperation between the two countries include life sciences, the environment and climate change, astronomy and space sciences, energy research and technology, material sciences, and nanotechnology (DST, Embassy of Japan; 2014: 5).

Adding impetus to the active STI cooperation, to be explored in more detail henceforth, are seemingly vibrant diplomatic relations between the two countries as evinced by a series of high-level visits exchanged e.g. dating back to President Thabo Mbeki's visit in 2001 where he proposed the partnership in science and technology (Brand South Africa, 2003) to President Jacob Zuma's visit in 2013 (The Presidency Media Release, 2013) and President Cyril Ramaphosa's 3 visits in 2019 to attend the 14$^{th}$ G20 Summit, Tokyo International Conference on African Development (TICAD VII) Summit, and 2019 Rugby World Cup and Minister Pandor hosting her counterpart in December 2020 (DIRCO Media Statement, 2020) and bilateral visits by successive SA Ministers of Science and Technology. In addition, Japan has repeatedly hosted SA Ministers at its Science and Technology in Society (STS) Forum (DST, Embassy of Japan; 2014: 6).

That S&T cooperation has formed an integral part of SA's bilateral relations with Japan is further supported by the DST having received three Japanese attachés since 1996, while it sent its first Counsellor of Science and Technology in 2004 (Masters, 2016: 181). In addition, in 2018 the DST supported the visit of the Portfolio Committee on Science and Technology visit to South Korea and Japan to learn about the science systems of these countries and to identify opportunities for SA (DST, 2019: 65).

The full scope of STI cooperation between SA and Japan cuts across various priorities and programmes including joint R&D (Japan Science and Technology Agency/JST collaboration with the NRF); joint research in natural science, social science, and humanities (Japanese Society for the Promotion of Science/JSPS collaboration with the NRF); university-to-university cooperation (SA-Japan Universities/SAJU Forum); technical cooperation (S&T attachés dispatched to SA, earth observation collaboration with SANSA); HCD (African Business Education Initiative, DSI-Hitachi Scholarship for SA Engineers, Tshwane University of Technology/TUT Cooperation with Japanese private companies); science engagement and communication (Japan International Cooperation Agency/JICA Science Volunteers dispatched across SA science centres) (DST, Embassy of Japan, 2014).

On the occasion of celebrating ten years of formal STI cooperation between the two countries in 2014, then-Minister Pandor remarked that "The cooperation between South Africa and Japan is an excellent example of a North-South relationship that can be leveraged to benefit both countries and their people" (DST, Embassy of Japan; 2014: 4). The Minister also highlighted some of the significant investments and achievements noting that "The strong bilateral relations between South Africa and Japan in science and technology are evident in the range of activities that have taken place since the signing of a bilateral agreement in 2003. The two countries have invested more than R85 million (over R72 million contributed by Japan) in more than 50 joint research projects and other programmes that have provided South African researchers, students and scientists with access to Japanese expertise and science facilities" (DST, Embassy of Japan; 2014: 4).

She further lauded the partnership in human capital development through the various exchange and training programmes for young researchers and engineers and the multitude of university-to-university memoranda of understanding that have been signed.

On the same occasion the Ambassador of Japan, Mr. Yutaka Yoshizawa, emphasised how the partnership has been steadily growing since 2003 and particularly acknowledged the significant role the Japan International Cooperation Agency (JICA) has played in strengthening S&T cooperation between Japan and SA (DST, Embassy of Japan; 2014: 7).

### 4.3.2. The significance of strengthened STI cooperation with Japan

The study pays particular attention to the Science and Technology Research Partnership for Sustainable Development Program (SATREPS) Programme driven by JICA and JST in collaboration with the DSI. JICA explains that its support to SA is primarily focused on: 1) Promotion of HCD and Infrastructure Development, 2) Promotion of Participation of vulnerable groups in Social and Economic Activities, and 3) Promotion of Regional Development in Southern Africa (JICA website; 2021). It is within this context that JICA and the DSI have implemented 4 major research collaborations under SATREPS, a highly competitive global research call. Launched by the Japanese government in 2008, SATREPS is a joint research Programme between Japan and developing countries that aims to find solutions to issues of a global scale, such as global warming, bio-resources, natural disasters, and infectious diseases, and is part of Japan's "science and technology diplomacy" collaboratively pursued by the S&T sector and the diplomatic sector to promote mutual development (JICA, 2017: 3).

The Programme supports projects under the specific themes: Environment/ Energy (Global-scale Environmental Issues), Environment/ Energy (Low Carbon Society/ Energy), Bioresources, Disaster Prevention, and Mitigation, and Infectious Diseases Control (JICA, 2017: 2). As part of Japan's ODA, SATREPS is implemented according to the five development cooperation principles of country ownership, a focus on results and accountability, inclusive partnerships, and transparency and mutual accountability. Masters (2016: 172) elaborates that the Japanese Council for Science and Technology Policy (newly named the Council for Science, Technology, and Innovation) has framed S&T as, "an emerging field of IR in which 'soft power' would play an ever bigger role", with the Japanese Ministry of Foreign Affairs dispatching S&T officers as science attachés to 27 different missions. The SATREPS Programme, being a flagship, demonstrates that, like other developed economies, Japan is also actively using S&T in its development cooperation and in the words of the CSTI's Prof. Taizo Yakushiji, "In

other words, science and technology has formed the backbone of Japan's development assistance policies" (Masters, 2016: 180).

From Japan's perspective, the SATREPS serves a triple purpose: pursuing domestic interests such as advancing science and develop capacity; addressing common global issues such as poverty, natural disasters, and conflict within the framework of the SDGs to alleviate their impact on the vulnerable in developing countries; and partaking in the international effort to achieve sustainable development (JICA, 2019: 3-4).

For SA, bilateral cooperation, and STI cooperation through ODA in particular, with Japan is quite strategic as on many indicators it is at the forefront of world science, and is among the leading OECD countries on measures such as R&D intensity and business R&D (OECD, 2008: 132). It is amongst the world's largest investors in science and innovation, spending almost 3.5% of GDP on research and development (R&D) in 2015, the third-highest in the OECD area (OECD, 2017: 1). With similar figures in 20016, such as high ranking is attributed mainly due to the business sector, which funded and performed 77% of R&D (OECD: 2008: 132); meanwhile, Japan had the fourth-largest number of researchers relative to total employment in 2006, with 11 researchers per 1 000 total employment, compared to an OECD average of 7.3.

The National Academies Press (2010: 51) notes that as a result of this heavy investment , Japan is a global innovation leader in several domains such as robotics and factory automation, biotechnology, nanotechnology, the deployment of systems of infrared and microwave sensors and radio transmitters along highways to alert vehicles of traffic hazards, the development of microgrids that can operate in connection with centralised grids but can also disconnect and operate autonomously.

Notwithstanding serious challenges in its S&T system including the immobility of personnel, inadequate entrepreneurialism, insufficient opportunity for younger researchers, and enduring problems with industry-university-government collaboration (The National Academies Press, 2010: 46) Japan is a great model from which SA could learn. Being a small country in terms of landmass and limited resources, it surprised the world with its use of S&T to propel itself from a relatively undeveloped country before World War II to a major manufacturer, global innovator, and one of the world's leading

economies (The National Academies Press, 2010: 46). Significant S&T efforts are used to address concerns over key national issues such as national security, raw materials, energy, and food availability, prospective epidemics, an aging population, low birth rates and immigration, and low participation of women in the workforce (OECD, 2017: 1; The National Academies Press, 2010: 46).

Most noteworthy is Japan's S&T strategy to increase government's R&D investment and enact major policy reforms to enhance innovation performance by improving industry-university-government collaboration; for instance, since 2004 separating its national universities and research institutes from the government's public service system, thereby giving them more autonomy to define their roles and allocate their resources, and more freedom to work cooperatively with industry (National Academies Press, 2010: 47).

In addition, although several ministries are involved in S&T policy, coordination is managed by a cabinet office- the Council for Science, Technology and Innovation/CSTI (formerly called the Council for Science and Technology Policy/CSTP) which reports directly to the Prime Minister which ensures attention to S&T policy at the executive level, giving Japan a potential advantage relative to other industrialised nations in terms of enacting transformational policies with long-term impact on research, education, and technology innovation (National Academies Press, 2010: 47). Further, with SA lagging far behind the global average of patent applications, much could be gleaned from Japan's major reform of its patent system towards a stronger protection of IP rights, not just through legislation but also the creation of an Intellectual Property High Court (2005), and promulgation of a series of action plans coordinated by the Prime Minister's Intellectual Property Policy Headquarters (beginning in 2002).

Among the suite of actions to address its poor innovation performance, the OECD (2017: 2) called on Japan to continue to strengthen the quality of public research including the links between universities and business, further enhancing the openness of the Japanese economy to foreign knowledge and technology including by continuing to encourage greater international mobility of researchers, strengthening the engagement of women in science, innovation, and entrepreneurship, and fostering the effective use of digital technologies by governments, firms, and individuals.

### 4.3.3. SA-Japan SATREPS partnerships

Since 2010 the DSI has been successful with 4 SATREPS projects: (2010-13) Prediction of Climate Change Variations and its Application in the Southern Africa Region led by the African Centre for Climate and Earth Systems Science (ACCESS) based at the CSIR, (2010-15) Observational Studies in South African Mines to Mitigate Seismic Risks in the Republic of South Africa also led by the CSIR and Council for Geosciences (CGS), (2014-19) The Development of an Infectious Diseases Early Warning System (IDEWS) in Southern Africa Incorporating Climate Predictions again led by ACCESS with the Medical Research Council, (2015-21) The production of Bio-Fuels Using Algal Biomass led by the Durban University of Technology and eThekwini Municipality.

The JST and JICA are in control of the project budget which is typically a Japanese investment of just over R60 million over the project period (usually 3-5 years) to support scientific research between the two countries and further ODA objectives. The investment supports research activities; costs associated with international conferences and training programmes in Japan; the secondment of a Japanese Project Coordinator to be embedded at a relevant SA lead institution for the duration of the project; procurement of equipment; participation of young post-graduate students in the project etc. (DST Newsletter, 2016: 2). The DSI's Development Partnerships Directorate in ICR commonly provides a small co-investment to the lead SA institution for the purchase of small consumables and to support the activities and mobility of local researchers domestically. Meanwhile, the lead institutions provide office space for the Project Coordinator and bear part of running expenses.

Taking a closer look at 2 of the SATREPS collaborations, the Seismology and IDEWS projects reveals laudable achievements as well as some challenges and interesting dynamics about SA-Japan STI cooperation. The analysis henceforth on the Seismology project is based on information contained in a series of official project plans and status reports at the DSI and JICA's disposal (unavailable publicly), project submissions at the DSI, the 2010 Memorandum of Understanding (MOU) between JICA and the government of the Republic of SA on "Observational Studies in South African Mines to Mitigate Seismic Risks in the Republic of South Africa, a 2015 Joint Termination Evaluation Report for the project: "Observational Studies in South African Mines to Mitigate Seismic Risks in the Republic of South Africa" compiled by an independent team of evaluators

appointed by the Japanese government, as well as an article by Gcino Mlaba in the DST April/May 2016 Newsletter titled “South Africa benefits from seismology research collaboration with Japan” (DST Newsletter, 2016: 2).

The main objectives of the Seismology project were to learn more about earthquake preparation and triggering mechanisms where seismic activity is likely to be induced or triggered by mining, learn more about earthquake rupture and rockburst damage phenomena, upgrade the SA surface national seismic network in the mining districts, and transfer technology and build capacity. Although a historical issue, by the time the project ended, disasters at local mines had placed the issue of mining safety in SA into sharp focus. For instance, the August 2014 earthquake in Orkney in the North West province which claimed one life and caused serious damage to property (IOL, 2014); as well the Lilly Mine disaster of 18 February 2016 where at least 75 miners had to be rescued and three surface workers remained trapped after a temporary office at the Barberton mine collapsed into a sinkhole (eNCA, 2016).

Within the collaboration, SA was represented by the CSIR and CGS (working closely with the mining companies) while Ritsumeikan University and the National Institute of Advanced Industrial Science and Technology (AIST) represented Japan. According to the five criteria of the Terminal Evaluation; relevance, effectiveness, efficiency, impact, and sustainability, all were rated high and relatively high except sustainability which was rated moderate to low due to some political/institutional and organisational/financial sustainability issues to be considered in SA. For instance, at the time the policy environment was not likely to be very favourable for the mining sector, which although still acknowledged as a key economic sector in the country, faces serious challenges such as a decline in production of mineral resources, threats of industrial strike, frequent changes of ownership of mines, and a decrease in the number of mining researches and research budgets for rock engineering. In addition, budget cuts at the CSIR would affect the possible continuation of project activities.

The project led to some notable achievements over the 5-years of implementation. The Japanese investment of about R60 million supported the development of research critical infrastructure, vibrant joint research and publications between the two countries’ research consortia, presentations are over 10 international conferences, travel, and networking for

the researchers, promotional activities, etc. Throughout the life of the project the equipment was used at research sites in 3 deep gold mines: Cooke 4 Shaft (previously Ezulwini), Hlanganani Shaft of the Kloof-Driefontein Complex (KDC), and Moab Khotsong and also to monitor seismicity using the network of ten surface seismic stations established in the Far West Rand.

As customary at the end of all projects implemented under SATREPS, JICA handed over all the equipment and material to the DST for the continued benefit of the SA partners, and on 2 October 2015, a Handover Ceremony was held at which the DST handed the equipment over to the CSIR and CGS. At this ceremony, the two institutions accepted ownership of the equipment and agreed to assume responsibility for its management and maintenance and utilise it towards further research on seismicity in SA mines.

Speaking at this ceremony, Principal Investigator from the SA side, Prof Ray Durrheim (Principal Geophysicist: CSIR Natural Resources & the Environment Unit), said “this is the largest and most ambitious mine seismology project ever attempted and we are truly grateful for the long-standing friendship and collaboration with our Japanese colleagues” (DST Newsletter, 2016: 2). He added that the knowledge gained during this project and the new seismic monitoring infrastructure that has been installed will improve seismic hazard assessment methods in SA mines and mitigate the rockburst risk. In addition, the new knowledge of earthquake physics will contribute to mitigating the risks posed by tectonic earthquakes.

In addition, as a result of this collaboration with Japanese researchers, sharing knowledge and skills, SA researchers are since then able to measure micro fractures and do numerical modeling and real-time observations and SA can record 100 times more events which directly relate to the increased ability to do numerical modeling and predict ground motion. SA’s measurement capability has increased from 2, 5 km to 3, 5 km deep. Basic rock testing has been done through the facilities at the University of the Witwatersrand (Wits) while advanced testing was done at the AIST in Japan.

The project provided SA with an additional 48 ground stations, improving coverage to 100 m from 1 km in the past. The collaboration resulted in the development of an algorithm that is instrumental in improved prediction. Concerning real-time observations,

it took between 2 to 3 weeks to identify the source of ground movement, and now it can be done in a few minutes. These improvements resulted in the M5.5 earthquake that occurred on 5 August 2014 in Orkney in the North West province being the best-documented earthquake in the world.

Another notable achievement was the project's contribution towards HCD as 13 students based at the University of Pretoria, Wits, and TUT pursued their postgraduate studies through participation in the project. Furthermore, the project led to numerous publications in international peer-reviewed journals, international presentations and talks; skills and technology transfer; improved understanding and knowledge of mining-induced seismology; and expansion of the seismic monitoring network infrastructure. From the research results, it was anticipated that recommendations would be made to the Department of Mineral Resources on the Mining Code of Practice. It was not possible at this time to verify the extent to which this ambition was realised.

The second SATREPS project, the IDEWS, implemented between 2014 and 2019 was also funded at just under R60 million and aimed to investigate the prevalence of infectious diseases at the household level and within the Health Care System to establish an early-warning system for infectious diseases in Southern Africa, incorporating climate predictions. The three diseases of interest include malaria, diarrhoea, and pneumonia with Limpopo as the core research area (DST-JICA MOU on IDEWS, 2014).

This project, at least from the SA side, brought with it some novel coordination in that it brought together for a common purpose a set of stakeholders across the national, provincial and local spheres who otherwise do not typically interact with each other.
Led by ACCESS located at the CSIR, the consortium comprised of the MRC, CSIR, Agricultural Research Council, South African Weather Services, University of Pretoria, University of Limpopo, University of Cape Town, University of Western Cape, National Department of Health (DoH), Limpopo Department of Health, and Tzaneen Malaria Institute.

Although at the time of writing it was not possible to gain access to the Joint Terminal Evaluation Report, official IDEWS progress and status reports at the DSIs disposal confirm that the administration and implementation followed the standard JICA format as

the Seismology project described above and made similar strides in terms of joint research and international peer-reviewed publications, presentations at international conferences, technical training workshops both in SA and Japan, and supporting young graduates pursuing their PhD and MSc degrees with funding and data towards their studies. In addition, as a science communication tool to engage colleagues and the general public, the project team held at least 2 lecture series annually where research findings and plans were shared and as a platform for networking (ACCESS 4th IDEWS Report, 2018).

However, one of the project's main outputs (the IDEWS as an operational technical system or innovation for use in SA) became a serious drawback at the end of the project. The intention was for the early warning system to be developed for its application in SA and later scaled to southern Africa and other regions, with the understanding that using it government institutions would gain access to useful data to better forecast, plan and prepare for, or prevent the onset of the diseases; resulting in a reduced number of people suffering from diseases (JICA, 2017: 56).

With the system refined and ready for operationalisation, challenges arose around its hosting (where it would be housed institutionally) and the financial sustainability to implement it. As the project was coming to an end, discussion and negotiations had not been concluded on whether it would be hosted by the National Institute of Communicable Diseases or South African Weather Services, and how the Post- Doctoral staffers suggested for 2 years would be funded (ACCESS, 2018: 7).

### 4.4. Conclusion:

This chapter has discussed two case studies representing strategic partnerships with the global North, namely STI cooperation with the UK as well as with Japan. Firstly, the chapter critically analysed these partnerships and highlighted their strategic significance and contribution to SA's international STI cooperation strategic objectives, to access funds to complement national investments; to enhance national and continental capabilities; and to maximise SA's strategic interests in international cooperation in STI.

Secondly, it highlighted the progress made thus far in SA's STI system and enduring constraints relating to stagnant economic activity; failures in human capital development,

building infrastructure, and forging a national innovation compact; erratic policymaking and poor implementation; governance weaknesses; the absence of a science diplomacy framework; and weaknesses in innovation policy. All these, we showed, undermine national ambitions about innovation and science diplomacy. Thirdly, the chapter discussed the key cultural, policy, institutional, and governance factors that have propelled the likes of the UK and Japan to be global leaders in STI. The next chapter will conclude and make some recommendations for consideration if SA is to fully realise its ambitious science agenda goals.

# CHAPTER 5

# CONCLUSION AND RECOMMENDATIONS

## 5.1. The argument

This research study set out to critically analyse the evolving vision, strategy, approach, and implementation of SA's science diplomacy in a rapidly changing world characterised by significant geopolitical and technological shifts with the emerging age of 4IR, and increasing recognition of the key role of STI in addressing national and global challenges. In so doing, it set out to highlight the implications of a set of key cultural, policy, governance, and institutional arrangements impacting the role and impact of SA's science diplomacy on advancing key national objectives as articulated in the NDP as well as key foreign policy goals. This was done through a brief exploration of four strategic STI partnerships driven by the DSI, as the principal custodian of SA's science diplomacy mandate, exemplifying how the country is navigating engagements with strategic North-South partners. Below we present the conclusions made by the study organized according to chapters to show the logic we sought to follow in making the argument of this mini-dissertation.

## 5.2. Conclusions

Chapter 1 presented the study rationale, which began with a description of the theme of science diplomacy while placing it in its policy and academic context. The study's concept of science diplomacy understood in the context of 4IR underlines the centrality of S&T in international cooperation. The context of this study underlines the complex, transformative and global nature of 4IR issues (socio-economic dimensions of technology development and adoption, and governance). The discussion shows that the evolution of S&T in SA society from apartheid to democracy saw the STI agenda aligned with the principles of the democratic constitution, a new international and continental positioning for SA, and foreign policy objectives. Science diplomacy implemented through strategic partnerships has come to represent innovation in SA's foreign policy rooted in the principles of ubuntu, pan-Africanism, south-south solidarity, and north-south dialogue. But it also presents challenges for the implementation of ideals. We show that SA's science diplomacy approach and agenda are entrusted to the DSI and this is expressed in even stronger terms in the White Paper on STI adopted in 2019. The White Paper places emphasis on

key systemic issues such as inclusion, transformation, partnerships, coherence and coordination, innovation, support to SMEs, 4IR, and Big Data and emphasises the fundamental role of STI in achieving the objectives of the NDP, Agenda 2063, and SDGs.

The White Paper underscores that achieving the ambitions of the NDP and science diplomacy agenda will depend on building an innovation culture in society and developing a science-literate and aware citizenry with the requisite skills and institutional arrangements to support and coordinate science engagement initiatives in SA. In addition, leveraging SA's strong record of international STI partnerships, the White Paper introduces a systematic approach to expanding the internationalisation of STI and science diplomacy with a strong focus on the African continent to support a pan-African agenda.

Despite this much growth in science diplomacy, the study moves from the premise that there is limited analysis of these developments individually or collectively. There is a dearth of works that seek to analyse whether and how "science diplomacy" is being translated into practice. Science diplomacy remains an underdeveloped field of study and practice and there is a need to understand its substantive evolution through the lens of the global South. While there is growing recognition of S&T as an enabler of solutions to major challenges facing humanity which are increasingly complex and global, how this finds expression in actual cooperation in science diplomacy especially between developed and developing nations is understudied. Thirdly, we show that the need to study science diplomacy and linking it to 4IR considering the pervasive societal changes brought about by disruptive technologies.

Therefore, the study was concerned with science diplomacy and how it is evolving alongside emerging 4IR. We posed the question: what is SA's approach to strategic partnerships in science diplomacy in the age of 4IR? Seeking to answer this question was designed to contribute to science diplomacy knowledge and policy developments, broadly, and enriching the analysis of SA science diplomacy; exploring its vision, strategy, and approach, and the implications of a set of cultural, policy, institutional, and governance arrangements on its role and impact; through a brief exploration of four case studies of strategic STI partnerships driven by the DSI.

To respond to these questions, we undertook a thematic literature review focusing on three themes: science diplomacy conceptualization and context, SA foreign policy, and science diplomacy architecture. We established that science diplomacy emerged in the context where there is an acceptance that diplomacy has to go beyond the official management of relationships between states but also involves non-state actors and has to involve non-traditional issues beyond security, politics, and economy.

The survey further reflected on the intense debate on diplomacy linked, firstly, to the traditional versus new diplomacy and, secondly, robust ideological and academic contestation between scholars and the global North and South on the epistemologies of knowledge traditions upon which international relations and diplomatic studies are built. The traditional versus new diplomacy debates tend to have dominated scholarly attention in the need to answer questions about diplomatic theory and practice, present interpretations of prominent diplomats' reflections over time, and distinguish between traditional and new practices in diplomacy introduced by the insertion of non-state role-players and new technologies in communications and transport.

We reviewed emerging voices that are challenging the dominant Eurocentric thinking about diplomacy and its practice on the basis that they represent epistemic injustice and they under-represent or misrepresent the views of the global South. These debates, therefore, challenge and resist the dominant epistemologies and knowledge traditions upon which international relations and diplomatic studies are built; and demonstrate how the histories, cultures, experiences from the global South matter and are critical to re-theorising diplomatic theory. We show that this opens avenues for re-reading diplomatic experiences and for reading new trends in diplomacy.

We showed that the discussions on science diplomacy are locked in matters of contextualising and framing debates. It is said by some that science diplomacy is predominantly characterised by advancing both direct and indirect national interests such as exercising "soft power", national security and emergency response, economic considerations, and STI on the national level; while also being seen as a critical multilateral tool to address global needs and challenges through the SDGs; and (as in the case of SA) seen to address the dual ambition of utilising STI to integrate and position the country internationally and continentally, and address domestic socio-economic

challenges through a “two-track approach” (Masters, 2016). In addition, there is a growing trend that identifies modes, issue areas, and tools of diplomacy which calls for a particular focus on an area of increasing knowledge specialisation within international relations and specialisation which requires an understanding of the technical details across scientific debates and the geopolitical context in which these negotiations take place.

In the discussion on what debates have revealed about SA diplomacy, we demonstrated that rooted in the diplomacy of Ubuntu, SA’s science diplomacy approach is discernible in the objectives of the DSI’s international STI cooperation agenda driven by the DSI. These objectives seek to strategically develop, promote and manage international partnerships that strengthen the NSI. They are about enabling the exchange of knowledge, capacity, and resources between SA and its international partners, with a focus on supporting STI capacity-building in Africa. The objectives also allude to support for SA foreign policy through science diplomacy. This mandate is also informed by the NDP goals to eliminate poverty and reduce inequality and unemployment. The chapter established that science diplomacy is an emerging and growing field of study and practice, marked by debates about how it enables foreign policy to better serve national and other interests in society. There are major developments in this field in South Africa in practice, but this is not matched by the amount and focus of writings on this subject so far.

Chapter 2 discussed the context in which science diplomacy is evolving in the world and SA and outlined this context, firstly by a discussion on the changing definition and conceptualisation of diplomacy. For instance, a context no longer characterised by inter-paradigm debates and contestation between TDT and NDT but greater theoretical diversity and divergent views on the nature and role of theoretical plurality as alluded to above on global South voices. In addition, it is a context defined by interrelated global crises, troubled global economy, and shifting geopolitics that has challenged traditional state-based diplomacy as the state is no longer the single key actor in a more complicated and diversified diplomatic system; and also characterised by great and rapid transformation imposed by major technological advancements. Furthermore, it’s a context where S&T has assumed a key role in the resolution of global challenges and where the resources might and ability to produce usable knowledge are critical.

Secondly, by conceptualising science diplomacy as an outgrowth of the changing definition of diplomacy, we described the conditions under which science diplomacy has grown in recent times and SA, demonstrating that SA's science diplomacy is underpinned by a pan-African agenda and focus on strategic North-South partnerships, as well as south-south cooperation.

We lastly outlined strategic priorities rooted in the NDP, SA's foreign policy goals, and policy intentions of the 2019 White Paper on STI, as well as its "two-track approach" in navigating strategic international partnerships.

Chapter 3 analysed aspects of SA's STI cooperation with China and trilateral cooperation funded by global North countries but implemented in neighbouring Southern African countries. The purpose was to show the focus of SA science diplomacy to the rise of China as a strategic South-South partner to attract knowledge and investments to boost the local innovation ecosystem and the drive to leverage resources and opportunities that complement a vision for a more integrated Africa with increased STI capabilities and infrastructure. The study examined the fledging SA-China Science Park Cooperation through which the two countries seek to complement their traditional R&D and HCD collaboration with a focus on innovation. This partnership, so far, has highlighted key factors that have seen China become one of the world's leading innovation economies with world-class science cities such as Shanghai. This has created opportunities for SA to learn and exchange its expertise. These areas of learning include a commitment to explicit long-term vision-setting and integrated planning and implementation across the spheres of government; commitment to policy reforms necessary for growth and development; societal culture towards education and S&T; investments in infrastructure and youth talent and skills; sound IP policies, etc. SA has a lot to learn in respect of such elements as long-term vision and planning; infrastructure development supporting science diplomacy and skills and capacities.

Secondly, the chapter analysed the experience of southern African countries with the trilateral cooperation facilitated by partnerships between SA, neighbouring countries, and USAID and Irish Aid. The cases of the potato project funded by Irish Aid and 8 R&D projects funded by USIAD were used to understand the details of this cooperation. This highlighted that while trilateral cooperation has had positive results and is generally a

preferred engagement mechanism due to the sharing of resources, benefits, and risks may make a good case for trilateral cooperation, the partners must be vigilant in the conceptualisation and planning phases to develop a shared set of values and expectations and to ensure inclusivity; ownership; and adequate technical capacities for coordination, implementation, and M&E.

This section of the chapter concluded that while trilateral cooperation may be a preferred delivery model for development, there are key considerations to be made in the programme planning phase such as the inclusion of the views of beneficiary countries in the design and management, taking stock of technical capacities, and keeping an eye out for values and attitudes inherent in development assistance. The DSI has to confront certain practices embedded in development assistance programmes that can undermine the end-goal of trilateral cooperation initiatives in the region

Chapter 4 took further the analysis of science diplomacy to the examination of case studies representing strategic partnerships with the global North. The first is STI cooperation with the UK and cooperation with Japan on the SATREPS programme. Over and above the objectives to access international funds, knowledge capacities, and resources to complement national investments in STI and enhance local and regional (and continental) capabilities, these partnerships also explicitly aim to maximise SA's strategic interests in international cooperation in STI in support of foreign policy objectives and international trade and investment partnerships. Collaboration with the UK bilaterally and through the EU Framework has secured commendable benefits for SA and the continent, especially in building STI capabilities. Another benefit is increasing the number of high-quality scientific publications. Being central to the success of major global projects like the SKA and participating in prestigious knowledge networks positions SA as a global knowledge player and potential beneficiary of enhanced international investments. However, the study also found serious systemic constraints, such as stagnant economic growth; inadequate public investment in R&D, a shortage of high-end skills; and an absence of a national innovation policy and national innovation compact, etc., that render SA a small player when compared to the likes of the UK and undermine articulated national objectives.

The Chapter concluded that these partnerships help SA achieve its international STI

cooperation strategic objectives to access funds to complement national investments; enhance national and continental capabilities, and maximise SA's strategic interests in international cooperation in STI and highlighted progress made thus far through the cooperation. However, it also highlighted structural and systemic constraints in SA's STI system relating to stagnant economic activity limiting the country's advances; constraints in human capital development needed to undertake the ICT transformation, limited building infrastructure; a lethargic national innovation compact; erratic policymaking and poor implementation, governance deficit; and the absence of a science diplomacy framework to give structure to international efforts in this area. In addition, the chapter found that there are the cultural, policy, institutional, and governance factors that have propelled the likes of the UK, and other regions, to be global leaders in STI that can be emulated in SA conscious of the specificities of its context.

Lastly, we reflected on the steadily strengthening STI bilateral relations between SA and Japan, and in particular two SATREPS partnerships aimed at simultaneously meeting scientific research, socio-economic development, and HCD objectives. These partnerships demonstrated the effective use of ODA as an instrument of bilateral relations to further STI cooperation between the two countries, although challenges were also highlighted in terms of the application of research results and future financial sustainability. The section also noted the strategic significance of cooperation with Japan, being among the leading economies in world science with- although not perfect- a sound S&T investment strategy, and policy and institutional regime to enhance innovation and pursue key national interest issues and global development.

Therefore, in respect of the research question behind this study, which asked what is SA's approach to strategic partnerships in science diplomacy in the age of 4IR? This study found that SA's science diplomacy is strongly aligned to the country's foreign policy, anchored in ubuntu diplomacy, South-South solidarity, and North-South dialogue. It is useful in enhancing South Africa's standing in the world in the age of innovation that the 4IR heralds. It enables the country to redefine its international cooperation and strategic partnerships through specific initiatives discussed here and many more than still need to be studied. The study also finds that the state has aligned the STI agenda to the principles of the Constitution. The democratic government has elevated the role of S&T as essential an tool for economic growth, global competitiveness, and social development, and

poverty alleviation.

The study concludes that the DSI, as the primary custodian of SA science diplomacy, has been quite deliberate and creative in its approach to strategic partnerships spanning different global regions to attract resources and investments to expand and strengthen the NSI, contribute to global knowledge production, apply STI in socio-economic challenges, and other objectives discussed above. The partnerships have also complimented SA's foreign policy objectives for regional integration and African growth and development; North-South political and economic bilateral relations; and strengthened specific solidarity with South-South partners. As Chapters 3 and 4 showed, notable strides have been made in the areas of NSI expansion and transformation, human capital development, knowledge generation, innovation for economic growth and development, building a stronger innovation ecosystem, inclusion of historically disadvantaged people and institutions, and positioning as a key player in big global scientific projects e.g. SKA.

However, as already mentioned above, the extent to which SA science diplomacy can maximise gains is limited due to several key factors. Key among these worth re-emphasising here is the absence of a science diplomacy engagement strategy. This means the country lacks a rallying vision or framework to bring together social partners in any formal and coordinated manner. SA's innovation performance also remains flat partly due to the absence of a national innovation policy. These suggest that while the country's intentions in science diplomacy are sound and the flurry of activities has increased, without an overarching vision/plan and strategy the objectives may not be achieved incoherent manner. This is a problem of governance of science diplomacy that needs SA to draw on the experiences of its partners for lessons on how it could remedy.

### 5.3. Recommendations

Considering the study findings and conclusions above, the following recommendations are made for the government and social partners under four broad themes: urgently address general public governance; harness and enhance an innovation culture, skills, talents; harmonise STI policy governance; and develop an evidence-based national engagement strategy for international STI cooperation.

### 5.3.1. Address general public governance:

The SA government needs urgent and serious reflection on the journey of democracy and the path it is currently on, especially as this relates to the state of governance. The last few years have seen major damage to public institutions and state capability built over years. This has led to a breakdown in systems, unabated corruption, brain drain and low morale in the public service, constrained policy coordination and implementation capacities; and as a result, a state that cannot deliver on its mandate as a supposed developmental state. In addition, such a state of affairs is not conducive to visionary leadership needed to address the chronic challenges faced by SA society especially in the science and technology domain. In the international STI field, which the study has found to be complex and rapidly changing, state capacity and governance have to be sharper if SA is to optimally leverage the investments and opportunities presented by global trends and partnerships.

SA society needs a government that takes seriously its role to protect citizens and deliver public goods, and can lead society on seeing through the transformation agenda; it needs economic growth well above current levels of below 1%; FDI; and dynamic economic activity to begin making a serious dent on poverty and unemployment. It is clear that without structural economic change the 1.5% GERD target will never be realized.

### 5.3.2. Harness and enhance an innovation culture, skills, and talents:

The government needs to be more pragmatic and devise an effective approach to address poor quality education in public schools, otherwise, generations of predominantly black children will continue to bear the brunt of a dysfunctional system that could never prepare them for the world as productive members of society, let alone a 4IR-world. Investments to promote STEM education and analytical and problem-solving skills from an early age would be critical and clearer, more formal interfaces are necessary between implicated Departments such as DBE, DHET, DSI, Labour, and relevant institutions e.g. Early Childhood Centres, Technical and Vocational Education and Training (TVET) colleges and HEIs.

This also requires investments in infrastructure in schools and public spaces, for instance, an expansion of science centres to remote parts of the country and townships; accessible data; and well evidence-based campaigns and official programmes to

encourage an innovation culture in communities and among start-ups.

SA should continue to seek greater international opportunities for HCD and student exchanges to strengthen capacities and expose young local scientists, researchers, innovators, and policy-makers to different country experiences and systems to enhance their skills and professional networks.

Lastly, the government, working with social partners- especially the private sector- to develop incentives to retain local and continental high-end capabilities and skills that are currently easily lost to wealthier contraries as a cost of successful science diplomacy by others.

### 5.3.3. Harmonise STI policy governance:

To address the fragmented policy environment and eradicate institutional role confusion and duplication, the SA government needs to devise a clear national innovation plan as one does not exist currently. Previously a Ten-Year Innovation Plan (2008-2018) existed and since the adoption of the 2019 White Paper on STI, NACI is to lead the development of implementation decadal plans and foresight studies. The challenge is that the process happens outside the existence of a social compact with key partners to the government such as business and civil society. The 2019 White Paper has prioritised building the innovation compact through a whole-of-society approach to innovation. This would be significant if this is achieved.

Secondly, although not perfect in their systems, the concerted efforts by Chinese and UK governments to substantively integrate innovation policy to key long-term national strategies e.g. industrial policy and sector strategies that can be updated periodically, are commendable and could be replicated in the SA context. This is essential for policy consistency and coherence and clarity on roles which is a challenge in the SA public policy landscape.

Linked to this would be an important undertaking to enhance human resources in this regard, build the policy skills and capacities of state officials as well as technical specialties in relevant areas. Through its STI international partnerships, the DSI- together with other departments and social partners- has started piloting holistic, agile design-led

policy making and implementation and experimenting with innovative methods for systemic change e.g. TIPC, GIPA, and Mission-Oriented Innovation Network. Evidence generated from these experiments could be useful in the possible application more broadly.

In addition, more formal linkages between departments that should coordinate across the system are also critical. For instance, DSI, DTI, Department of Labour, as well as science councils. These linkages are critical as building blocks to a solid NSI and the strategic activities it can conduct to meet national and foreign imperatives, as shown by the systems in China and the UK.

Lastly, SA needs to bolster its IP regime and the R&D Tax Incentive scheme to drive innovation across society and the commercialisation of publicly-funded IP.

### 5.3.4. Develop an evidence-based international STI engagement strategy:

With the benefit of evidence since formalising the SA science diplomacy agenda and key priorities, as well as emerging science diplomacy literature in diplomatic studies, the DSI should lead the process of developing an inclusive, evidence-based national strategy for STI engagement to guide all of society and maximise leveraging RDI investments and other resources into the country and region.

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