

The Role of Science, Technology, and Innovation Policies in the New National Development  
Plans: A Gender Analysis

Similola Adekolu

Student Number: 300104529

April 15, 2022

Major research paper done in partial fulfilment of the requirements for the MA degree in  
International Development and Globalization under the supervision of Dr. Lauchlan T. Munro.

School of International Development and Global Studies  
Faculty of Social Sciences  
University of Ottawa

Word Count: 14,985



## **Abstract**

With the unprecedented rise in global economic and gender inequalities and the impacts of the COVID-19 pandemic, planning has become imperative. Countries are now adopting a structured approach through the National Development Plans (NDP) to implement the Sustainable Development Goals (SDGs). This paper contributes to the scholarship on planning by applying a gendered lens in assessing the role of Science Technology and Innovation (STI) and the emerging Fourth Industrial Revolution Technologies (4IR) in the NDPs. This paper conducts a content analysis of South Africa and Pakistan's STI policies and the STI section of the NDPs of the Bahamas and Congo and finds that all these documents misconstrue the meaning of gender to mean 'binaries,' which impacted how gender STI goals were articulated in the plans/policies. The feminist institutional theory shaped the understanding of the role of history, gendered formal and informal rules, and socio-cultural and institutional barriers in NDPs and STI policies.

Of the four countries, South Africa ranked first, and Pakistan ranked last based on a combined assessment of their Frontier Technology Index (FTI) scores, plan orientation, gender, diversity and inclusion consideration, and judgment criteria (evidence and scenarios). The key gaps across all the plans include gender neutrality and lack of STI gender-disaggregated data except in South Africa, technocratic style without social embeddedness, lack of clear funding model, lack of a coherent Intellectual Property framework and monitoring and evaluation system. This study argues that there is a need to consider gender assumptions and implications in STI policies and NDPs. Also, there is a connection between STI/frontier technologies and development, but not all countries will adopt it simultaneously, especially the Bahamas and Congo, with relatively small population sizes and limited resources. Technology is rarely a solution alone, and since developing countries grapple with broader multidimensional issues, it is important to link STI goals with other social and economic policies. STI also needs to be considered carefully to limit unintended consequences.

**Key Words:** Gender, National Development Plans (NDPs), Science Technology and Innovation (STI) Policies, Fourth Industrial Revolution (4IR) technologies, Feminist Institutional theory

## Table of Contents

<b>Abstract</b> .....	<b>2</b>
<b>Chapter 1: Introduction</b> .....	<b>5</b>
1.1 Background .....	6
1.2 Research Questions .....	8
1.3 Countries Selection .....	9
1.4 Methodology and Theoretical Framework.....	10
1.5 Justification .....	10
1.6 Limitation of the Study .....	11
1.7 Structure of the Paper.....	11
<b>Chapter 2: Literature Review</b> .....	<b>12</b>
2.1. Evolution of Planning .....	12
2.2. Market Failure and Government Intervention.....	13
2.3. NDPs and STI Policies.....	15
2.4. What is “Gender?” and Approaches to Gender Consideration in National Planning.....	17
2.5. Connecting STI Policies and NDPs to the SDGs.....	19
2.5.1 Connecting NDPs and STI Policies to Gender Equality.....	19
2.5.2 Connecting NDPs and STI Policies to the other SDGs.....	21
2.5.3 STI Policies and Covid-19 .....	24
2.6. Social, Political and Institutional Barriers to Gender Considerations in STI Planning ....	25
2.7. Research Gaps.....	29
<b>Chapter 3: Theoretical Framework and Methodology</b> .....	<b>30</b>
3.1 Theoretical Framework .....	30
3.2.1 Feminist Institutionalism.....	30
3.2.2 Feminist Critical Policy Analysis (FCPA).....	31
3.2 Methodology .....	32
3.2.1 Content Analysis .....	32
3.2.2 Transforming the FTI Index.....	35
<b>Chapter 4: Case Study and Analysis</b> .....	<b>37</b>
4.1 Background and Plan Outlook .....	37
4.2 Focused Result Analysis .....	39
4.2.1 The Bahamas.....	39
4.2.2 The Republic of Congo .....	43
4.2.3 Pakistan .....	46

4.2.4	South Africa .....	49
4.3	Focused Countries Comparison .....	52
4.3.1	Focused Comparison 1: Bahamas Vs Congo .....	53
4.3.2	Focused Comparison 2: Pakistan Vs South Africa .....	54
4.3.3	Key Gaps across all the Plans and Links to the Literature.....	56
4.3.4	Theoretical Explanation of Results .....	58
4.3.5	Overall Rank .....	59
<b>Chapter 5: Summary, Conclusion and Recommendation .....</b>		<b>63</b>
5.1	Summary .....	63
5.2	Conclusion .....	63
5.3	Recommendations.....	65
<b>Bibliography .....</b>		<b>68</b>
<b>Appendix.....</b>		<b>75</b>

## Chapter 1: Introduction

This Major Research Paper (MRP) explores the intersection of gender, National Development Planning (NDP) and Science, Technology, and Innovation (STI) policy in four developing countries: the Bahamas, the Republic of Congo, Pakistan, and South Africa.

The “theory of market failure” rationalizes the role of the state in planning (Wallis & Dollery, 1999) and the government’s stabilization efforts to reverse uncertainties created by market downturns, inefficient factor prices, and the need to promote economic growth (Chimhowu et al., 2019; Oyelaran-Oyeyinka, 2014). Based on Samuelson's (1954) argument, in the case of collective consumption goods which also applies to STI, no decentralized pricing system would optimally determine their production levels. STI has positive and negative externalities that may not be reflected in their prices, resulting in underinvestments by the private sector.

Also, STI policies transcend economic goals to environmental, cultural and social goals on gender equality and inclusion, which means the government must make policy decisions and ensure sound policy implementation (Smits et al., 2010). Many countries now have NDPs, and the term “new” used by Chimhowu et al. (2019), which this study adopted, refers to the contexts in which the current generation of NDPs are emerging and the renewed global interest in national development planning.

National planning went out of style due to economic liberalization in the 1980s and 1990s, but most nations now have NDPs, up from 62 to 135 in the last decade (Munro, 2020). Most of these NDPs feature STI policies, or the STI policies are articulated in a separate document as there is a growing recognition that planning is essential for technological transformations (Oyelaran-Oyeyinka, 2014) and achieving the Sustainable Development Goals (SDGs) (Hosein et al., 2020).

However, STI policies and NDPs would not foster equitable and sustainable development without applying a gendered lens (Hosein et al., 2020; UNCTAD, 2011) and how gender is construed impacts how it is applied in policies. A gender lens to STI policy allows for mobilizing STIs for development. This approach transcends “add women and stir” to ensure that men and women’s positions and other equity-seeking groups are considered. Therefore, this MRP seeks to answer how and to what extent gender considerations appear in current STI policies and NDPs using these four case study countries?

## **1.1 Background**

Solow’s growth model is considered the starting point for growth analysis, and it constitutes labour, capital and a constant “ $t$ ” that allows for a technical change in the production function (Solow, 1957). The “residual” in the Solow growth function is “technology” and is often referred to as “Total Factor Productivity” (McCombie, 2010; Gundlach, 2005). Economists Samuelson and Nordhaus identified land, labour, and capital (Samuelson & Nordhaus, 2010), while Klein (1988) recognized entrepreneurship as a factor of production. In contrast, other scholars built on Solow’s theorization of technology as a “unique” factor of production because of its substitution and displacement effects (Youmans, 1967; Dewan and Min, 1997; Acemoglu and Restrepo, 2019).

Some authors argue that if an economy does not consider technology, the diminishing returns in other factors of production will slow down economic growth (Nishimizu and Page, 1982; Crespi and Dutrenit, 2014). The growth of labour productivity in emerging markets since 1990 was partly due to capital deepening, the capacity to adopt new technologies and allocate resources efficiently (OECD, 2015). Innovation has been one of the critical drivers for the cumulative increase in productivity growth in most industrialized nations and the Asian Tigers (McKinsey,

n.d.). Structuralists theorize that aside from the role of the market, the government's role in facilitating structural changes is critical (Furtado and Macedo, 1990; Lin, 2012; Taylor, 2004).

With these arguments on the government’s role in planning and the transformative role of STI, the “new” NDPs are now tied to how international norms like the Sustainable Development Goals (SDGs) are operationalized. However, certain NDPs are developed by political elites and technocrats without “social embeddedness” or buy-in from non-state actors like the Type A and Type C NDPs (See Figure 1 below). Fig. 1 is a 2x2 matrix that sorts plans on whether they are based on “a linear or collaborative conceptualization of rationality, and whether they are strongly evidence-based or weakly evidence-based and socially embedded” (Chimhowu et al., 2019).

Fig. 1: Functional Classification of National Development Plans

<p><b>Type A (26%)</b>            Largely top-down process            Rational blue print            Strong evidence base            Limited social embeddedness</p>	<p><b>Type B (42%)</b>            Largely bottom-up process            Communicative Rationality            Strong evidence base            Socially embedded</p>
<p><b>Type C (12%)</b>            Largely top-down process            Disjointed blue print            Weak evidence base            Limited social embeddedness</p>	<p><b>Type D (20%)</b>            Largely bottom-up process            Communicative Rationality            Weak evidence base            Socially embedded</p>

Source: Chimhowu et al. (2019)

Given the weaknesses in how some of these NDPs are constituted, experts argue against their relevance. While these documents are not ends in themselves, they are means of setting social, economic, and political priorities with internal and external stakeholders (Chimhowu et al., 2019).

NDPs or STI policies can serve as a basis for setting strategic direction, accountability, discovering future gaps, and planning for gender equality.

## **1.2 Research Questions**

In addition to applying a gender lens to reviewing STI policies and NDPs, this research evaluates the role of fourth Industrial Revolution (4IR) technologies like Artificial Intelligence (AI), big data, augmented reality, renewable energy and drones in STI policies and NDPs, and their relevance for pandemic preparedness by reviewing recent plans (where available). The overall research question is how and to what extent gender considerations appear in recent STI policies and NDPs using a case study of four countries the Bahamas, Congo, Pakistan, and South Africa? The specific questions include:

1. What role does gender play in national planning? Do the STI policies and NDP address gender issues, and if so, how?
2. What sociocultural, institutional, and political barriers impact gender considerations in NDPs and STI policies?

A directed and summative content analysis of the NDP and STI policies of the four countries will be used to answer question one. However, as Hsieh and Shannon (2005) argued, using theories under the directed content analysis has inherent limitations because researchers approach the data with a strong bias. For instance, some theories like feminist institutionalism and Bacchi's (2009) Critical Policy Analysis approach frame gender to mean men and women, ignoring other equity-seeking groups, which limits their use for a more inclusive review of the NDPs and STI policies.

Therefore, this MRP will complement the analysis of these NDPs and STI policies with summative and conventional content analysis. In this case, conventional content analysis will

allow for deriving codes through the data, while summative content analysis will allow for counting and comparison of keywords, followed by an interpretation of the underlying context (Hsieh and Shannon (2005)). This MRP will review the literature on gender and planning to provide evidence on the socio-cultural, institutional, and political barriers that impact gender considerations in STI policies and NDPs to answer question two. Ultimately, this research will recommend the areas that policymakers and academia should consider going forward.

### 1.3 Countries Selection

I wanted a spectrum of cases to illustrate the maximum level of diversity in the same country. Hence, regional, income level, size and legal frameworks were considered in the country selection in Table 1.

**Table 1: Criteria for Country Selection**

Country	2021-22 World Bank country classification by income level	Availability of NDPs or similar documents	Availability of explicit STI policy	Legal gender recognition	Absence of criminalization of LGBTQ+ rights	Legal consideration of the rights of persons with disability
The Bahamas	High Income Country	Yes	No	Partly	Partly	Yes
South Africa	Upper Middle-Income Country	Yes	Yes	Yes	Yes	Yes
Pakistan	Lower Middle-Income Country	Yes	No	Partly	No	Yes
Democratic Republic of Congo	Low Income Country	Yes	Yes	Partly	Partly	Yes

*Source: Author's analysis*

While most upper-income countries have embraced gender rights or diversity like the United States, Britain, or Norway, they do not have NDPs; hence the Bahamas was selected. South

Africa is the only African country to have legalized gender diversity. Also, the consideration for Congo and Pakistan is that they have relatively progressive legal considerations on paper that protect the rights of people whose gender does not conform to the sex assigned at birth, compared to similar countries in the same region and income level. In most developing countries, the tolerance for legal gender recognition is very low, and there is still legal discrimination against non-binary persons, even criminalization.

#### **1.4 Methodology and Theoretical Framework**

This study is rooted in feminist institutionalism and the Critical Policy Analysis approach, otherwise coined by Bacchi (2009) as “what is the problem represented to be?” (the WPR Approach). Feminist institutionalism will help examine the impact of gender blindness in STI policies, while the critical policy theory will unpack how gender and gender relations are produced through social relations and other dimensions of power like ethnicity, race, and class (Bacchi, 2009; Rönnblom and Keisu, 2013). As stated, directed content analysis will be used to assess the text data of the STI policies and NDPs of the four selected countries, complemented by conventional content analysis to understand the language of these plans. A summative analysis will be used for specific word counts and the importance of terms (Hsieh and Shannon, 2005).

#### **1.5 Justification**

The nature of STI policies and the social issues around gender equality means the market cannot deliver these goods equitably and create socially optimum outcomes. Therefore government policies have a role in overcoming these market failures. Secondly, conceptualizing gender equality as binaries impacts institutions, policies and practices. Considering intersectionality in planning frameworks will help unpack the complexities of power relations and

provide a balanced discourse. It will also help analyze the complexities of privilege, exclusion, marginalization and inequalities in NDPs and STI policies.

## **1.6 Limitation of the Study**

Given that the literature on gender and STI planning is nascent, this research will contribute to knowledge by focusing on a content analysis of these plans, but the full or final analysis should transcend a review of these documents to a thorough assessment of context-specific processes and practices. This study will review open-source materials such as news reports, blogs, and op-eds (if available) to overcome these limitations. Also, while planning is essential, there is a need to research the disconnect between planning and practice. Another limitation of this study is the small sample size of four countries.

## **1.7 Structure of the Paper**

This study starts with an introduction, and the second chapter covers the literature review of academic and grey sources. The third section includes the theoretical framework and methodology, while the fourth section covers the empirical analysis and comparison of the NDPs and STI policies of the four case study countries. In the fifth chapter, I conclude with policy recommendations and areas for future research.

## **Chapter 2: Literature Review**

This chapter will describe the evolution of planning and synthesize the literature on NDPs and STI policies, the meaning of gender and approaches to gender mainstreaming of NDPs. It will also analyze the connection between NDP and STI policies with the SDGs, gender equality and the barriers to gender considerations in planning.

### **2.1. Evolution of Planning**

Amadi (n.d.) describes planning as a mechanism to coordinate and mediate between conflicting interests of public and market forces. It is an instrument used to set quantitative targets and sustainable development (Green, 1965). On the other hand, development plans are master plans that are more encompassing and involve a nation's vision, policies, and programs and require the participation of the active beneficiaries of the plan. Planning covers social, human, political, environmental, and technological goals (Amadi, n.d.).

Agarwala (1983) argued that the intensity of planning in developing countries was due to three main reasons: the apparent success of Soviet plans, Europe's wartime experience with planning and the structuralist orientation of development economics. The Soviet Union initiated a five-year plan in the late 1920s, which led to the industrialization of the USSR. Secondly, the experience of the United Kingdom during World War II also led to the popularity of national planning. The government successfully rationed goods and services and foreign exchange rates. Planning was also strengthened by the ideas of early development economists such as Hirschman, Rosenstein-Rodan, Myrdal, and Lewis. This school of thought assumes that social, cultural, resource flow and institutional rigidities are not responsive to prices, and the state has an important role in overcoming these rigidities (Agarwala, 1983; Öniş, 1991).

In most developing countries, planning predates the colonial era, and it was mainly based on local customs and practices. In Nigeria, planning was tailored to physical planning in the 1800s through the promulgation of the Town Improvement Ordinance Act in 1863. Ghana had its first 10-year plan in 1919, and the British colonial development plan was the standard policy from 1939-40 (Green, 1965). During the colonial era, planning took the form of a ten-year plan and became six years of plans after independence in 1960 in Nigeria (Amadi, n.d.). It became a five to seven-year development plan in Ghana, Kenya, and Tanzania (Green, 1965). The African movement and independence led to rapid growth and expansion in national planning. African states, including those with a conservative government, are becoming aware that national, social, and economic planning efforts should be channelled into the “rapid improvement of living standard and economic capacity” (Green 1965).

Yirenkyi-Boateng (2010) recognized the role of NDPs in the post-political-independence development processes of African countries. There is also the need for a shift in perspective from the predominantly colonial development plans that created obstacles for the African population to participate in the “new formal capitalist system.” Agarwala (1983) argued that countries that performed best were not necessarily those with a high degree of planning efforts. However, those who streamlined incentive systems emphasized coordination and consultation within the private and public sectors rather than top-down technical expertise.

## **2.2. Market Failure and Government Intervention**

Samuelson (1954) identified “jointness” and “non-rivalness in consumption” as characteristics of public goods. Samuelson uses the illustration of an “analogue calculating machine” to describe how production can be done by competitive market pricing so long as the production function satisfies the neoclassical assumption of constant returns, with perfect

competition among productive enterprises that ensures goods are produced at minimum costs and sold at marginal costs. In this case, the institutional framework would have to be maintained, and political decision-making through taxes and transfers will be used to ensure the society is “swung to the ethical observers optimum.” However, in the case of collective consumption goods like STI gender equality, Samuelson shows that no decentralized pricing system can optimally determine these consumption levels.

One of the most successful attempts to resolve the question of the appropriate role of the state was by welfare economists through the “theory of market failure” (Wallis & Dollery, 1999). Stiglitz (1993) recognized five types of market failure: information asymmetry, market power, complementarity, externalities and public goods, which would require government intervention to promote economic efficiency and equity. The global financial crisis has also intensified this debate, with advocates for intervention suggesting the need for regulation and appropriate fiscal policy instruments without losing the benefits of a competitive economy (Wu and Ramesh, 2014). The government needs to put in place measures to guard against “regulatory capture,” “arbitrage,” and “forbearance” in order to control the market’s excesses (Aikins, 2009).

Clutton-Brock et al. (2019) also assessed the rationale for government intervention in frontier technologies like Artificial Intelligence (AI). Despite the benefits of AI in climate change and energy, there is a significant risk that AI will fail to support the transition to a zero-carbon economy at a required and equitable pace. There are risks of incumbent monopolies and technology companies exerting pressure and shaping market prices. STI has positive and negative externalities that may not be reflected in their prices, resulting in underinvestments by the private sector.

Ghazinoory and Ghazinouri (2009) analyzed three reasons why the role of government is essential in STI, using the case study of the National Iranian Nanotechnology. The first is incomplete adoption, where apparent market failures characterize innovation, knowledge and information. Secondly, the uncertainty is tied to the production of knowledge and information and, thirdly, the economies of scale of technology where the government must help protect intellectual property rights and technology diffusion.

Smits et al. (2010) argued that the rationale for government intervention in STIs is subject to intense debate. The objectives of most STI policies are economic ones, but there are others like cultural, social, environmental, or military. According to mainstream economists, there are three characteristics of scientific knowledge “uncertainty, inappropriability, and indivisibility,” which could lead to under-investment in R&D by the private sector than what will be desirable from an economic and social point of view.”<sup>1</sup> Ghazinoory and Ghazinouri (2009) framed the role of the government in STI as policy intelligence, policy decisions and policy implementation through four tools direct intervention, regulation, offering incentives and promotion.

### **2.3. NDPs and STI Policies**

NDPs are termed “new” because they differ from the language and methodology that pervaded the 1950s through the 1980s and the rationale of planning is rooted in linear rationality and top/down approaches (Chimhowu et al., 2019). The NDPs are a reaction to three significant trends- economic liberalization, marketization, and deregulation. These trends, especially the

---

<sup>1</sup> “Uncertainty refers to the impossibility to fully know the outcomes of the research process and the risk associated to it. Inappropriability means that firms cannot fully appropriate the benefits which derive from their inventions. There will always be externalities emanating from the research process. This means that the incentive for research activity by firms is smaller than it would be if it was possible for firms to appropriate all the benefits. Indivisibility implies that there is a minimum investment in knowledge before any new knowledge can be created.” See (Smits et al., 2010).

financial and economic shocks they amplified, promoted inequality and deterioration in living standards, necessitating planning (Chimhowu et al., 2019).

Munro (2020) analyzed five major factors contributing to the resurgence of NDPs. The World Bank's Heavily Indebted Poor Countries Initiative (HIPC) and the associated Poverty Reduction Strategy Papers (PRSPs), the response of the government to SDGs, and the need for a Results-Based Management Framework (RBM). The third factor is emerging economies with a high state capacity that use NDPs to manage the downside of economic globalization, like China, Russia, Turkey, and Algeria. The potential of NDPs to promote transformative national agenda is another factor and, finally, "development dissidents," where NDPs are used to promote policy agenda that privileges national sovereignty and global economic integration over democracy contrary to the SDGs (Munro, 2020).

The duration of NDPs ranges typically from four to six years. Most plans are medium terms (five years) that may or may not be accompanied by a long-term vision (twenty years or more). These medium-term plans are also often built from the longer-term SDGs. These five-year plans correlate with the political calendar, especially a democratic transition. STI policies and strategies are embedded in NDPs or as different policy frameworks in most developing countries.<sup>2</sup> For instance, South Africa has had a distinct National Innovation Strategy separate from the NDP since the early 2000s (Flowerday, 2015). Pakistan also developed the first National Science and Innovation Policy in 2012 (Ali et al., 2020).

Yirenkyi-Boateng (2010) argues that the nature of NDPs can play a role in the transformation of citizens' lives and calls for the need for development planning authorities in

---

<sup>2</sup> Brazil, China, Egypt, India, Malaysia, Saudi Arabia, UAE, Vietnam have National Science, Technology and Innovation strategies embedded as risk management strategies in their NDPs (Munro, 2020)

developing countries to take seriously how development plans are constituted. Manyena (2013) calls for post-colonial states to integrate NDPs into a single participatory framework through civil organizations and champions of change that will serve as “watchdogs” to preserve the democratic approach of the planning process. This approach will also improve coordination and resource mobilization.

#### **2.4. What is “Gender?” and Approaches to Gender Consideration in National Planning**

Sex and gender are often used interchangeably despite differences, but gender literature now distinguishes between these concepts. Sex refers to biological characteristics such as physical and sexual features that differentiate a man from a woman (Zalewski, 2010). However, several people fall outside the gender binary, and this non-binary identity has been present over time and across various cultures (Richards et al., 2016).

Gender refers to the socially constructed roles, ways of behaviour, skills, and interests men and women are expected to have because of their biological sex (Valenius, 2007). It is the roles and behaviour that society considers for men and women, which means that since these systems are socially created, they change over time. Gender does not mean women but relations between and among men, women and gender-diverse people. Therefore, men and women experience these relations from radically different personal, social, economic, and political power (Hosein et al., 2020). The definition of gender impacts how it is considered in policies.

The prominence of gender mainstreaming can be traced to 1975, when the United Nations (UN) and most western countries acknowledged gender inequality (then called women’s discrimination) (Lomazzi and Crespi, 2019). Also, the UN platform for action in 1995, where all signatories were expected to implement gender mainstreaming (Fourth World Conference on Women, Beijing 1995, n.d.), reinforced the need for gender considerations in policies. Gender

mainstreaming is a strategy that aims to bring gender equality and advance the rights of women by incorporating gender-sensitive analysis into national planning (Moser and Moser, 2005; Schmidt, 2005; Mainlay and Tan, 2012).<sup>3</sup>

Moser and Moser (2005) leveraged Rounaq Jahan's theorization of approaches to mainstreaming as "integrationist" and "agenda" setting. The integration approach is evident in the anti-poverty, welfare, and efficiency approach to Women in Development (WID). This approach seeks to include women like men in planning frameworks, but it often views women as a marginalized group that needs special intervention. Feminists have critiqued this approach as "add women and stir." The integrationist approach ignores unequal gender power relations, and it misunderstands the economic role of women in developing countries.

The agenda-setting approach was proposed as the panacea for the weaknesses of the integration approach. Schmidt (2005) argues that the origin of gender inequality is not the individual understanding between men and women but gender hierarchy in a society where power exists between people and how it is interpreted. The state and institutions play a role in how power is interpreted, which means they are also responsible for eliminating gender inequality. Agenda setting will allow for the equal participation of gender groups in social institutions (Moser and Moser, 2005; Kapungu, 2008; Hosein et al., 2020).

According to Moser and Moser (2005), "Gender" has itself been depoliticized and transformed as a field of research and action, as opposed to leading to transformed development which genuinely supports the empowerment of women- as people who have control over their lives both individually and as a marginalized group. Mainlay and Tan (2012) argue that gender

---

<sup>3</sup> Also see Association for Women's Rights in Development, 2004

mainstreaming is not an end but a means of achieving more equitable, sustainable, and effective programs and policies and, eventually, social, economic and political outcomes.

## **2.5. Connecting STI Policies and NDPs to the SDGs**

A few studies have examined the connection between STI policy and the SDGs (Yongabo and Gorasson, 2020; Walsh et al., 2020; Aminullah, 2020; Cozzens, 2008; 2021). UNCTAD's (2011) study examined some pathways through which STI policies promote gender equality and development progress, including how STIs can contribute to agriculture, water, energy, transport, and other livelihood activities. This section will analyze the link between STI policies, gender equality, other SDGs, and pandemic preparedness (Covid-19).

### **2.5.1 Connecting NDPs and STI Policies to Gender Equality**

The empirical literature on the role of gender in STI policies and NDPs, and the outcome on development is evolving. The Beijing Platform for Action, adopted at the fourth conference on women in 1995, calls on government and stakeholders to increase women's access to and retention in S&T (Fourth World Conference on Women, Beijing 1995, n.d.). UNCTAD (2011) recognizes that a gender lens in STI policies and development plans should reflect the aims, concerns, situations and abilities of both men and women in all aspects of STI policy-making.

Some studies examined how women's participation in science, technology, engineering, and mathematics (STEM) disciplines impact gender equality (Lee, 2013) or the employment of women in STEM (Kim and Park, 2011; Tiedeu et al., 2019); some authors examined the international mobility strategies for women in innovation careers (Ramos and Bosch, 2011; 2013). UNESCO also argues that the participation of women in STEM is uneven, and it impacts gender equality (UNCTAD, 2018).

Some national policies undermine women's participation in STIs, even when these plans emphasize the SDGs. In contrast, success indicators in most NDPs in the Caribbean considered the need for inclusion and gender equality in achieving the SDGs (Hosein et al., 2020). The Caribbean NDPs considered "tertiary schooling for girls in STEM, women's access to reproductive health care, women's access to income, women's ownership/control of land or assets, women's inclusion in decision-making." Lee and Pollitzer (2016) argued that innovation systems need to take a "gendered innovation" approach to achieve socio-economic growth.

UNCTAD's (2011) study examined how STI policies promote gender equality and development progress. SDG 5 seeks to provide women and girls equal access to education, health care, decent work, and representation in political and economic decision-making processes (Goal 5: Gender Equality - SDG Tracker, n.d.). Women play essential roles in agriculture, water, energy and transport, which suggests that STI could significantly contribute to women's livelihood activities in food production and processing and household energy consumption.

STI can improve women's access to information and technical assistance as entrepreneurs and farmers. It can improve women's access to science education and training, non-traditional employment, and women's role in natural resource management (UNCTAD, 2011). UNCTAD (2019) highlights how STI played a vital role in empowering and giving voice to people, including the vulnerable, through access to education, health, and information on environmental risks.

STI, especially frontier technologies like big data, the Internet of things (IoT), AI, 3D printing, biotechnology, nanotechnology, renewable energy, and drones, have shown tremendous potential for sustainable development (UNCTAD, 2018 and 2021). For instance, AI and robotics can transform production and business. IoT is being used to advise on farming techniques in Nigeria, where women play a significant role, and 3D printers are being used to promote fashion

items in Columbia. “Bio-entrepreneurship” can also contribute to livelihoods in rural communities, where women are predominant. Other examples include IoT to monitor groundwater quality in Bangladesh and drones to deliver medical supplies to remote communities in Rwanda and Ghana to improve maternal health (UNCTAD, 2021).

However, some of these technologies affect inequalities through access and design for women and vulnerable groups, as I will describe in section 2.7. STI has unintended consequences and can increase inequalities through jobs, wages, and profits by creating new digital divides. For instance, AI robotics may destroy jobs in low-wage assembling and services industry and could further complicate the lives of women who rely on subsistence agriculture in developing countries. Social norms restrict access to technology for women, ethnic minorities and other disadvantaged groups (UNCTAD, 2021). UNCTAD (2021) advocates for women’s access to STIs and women’s involvement in setting STI priorities.

### **2.5.2 Connecting NDPs and STI Policies to the other SDGs**

The overarching principle of the SDGs is to “leave no one behind.” The SDGs are grouped into 17 goals and 169 targets that cover three components, environmental (saving the planet), social (bringing people to life), and economic dimensions (creating economic prosperity) (Aminullah, 2020). UNCTAD (2017) proposes that technological innovation is essential for tackling the issues of structural transformation required to achieve the SDGs, especially in developing countries. “The role of STI for SDGs is to create economic prosperity without bringing a social and environmental burden” (Aminullah, 2020). The first step to promoting technology and innovation is to develop coherent STI policies.

The 2018 SDG Index showed that there is still a long way to go to achieve the 2030 SDGs, and no nation is on the path to achieving all these goals (SDG Index and Dashboards 2018, n.d.).

High-income countries are further complicating issues through significant environmental, economic and security spillover effects that impact other countries' efforts towards achieving the goal (Walsh et al., 2020). Walsh et al. (2020) also argued that "STI solutions have the potential to contribute to transformative actions that can reorient production, promote equality and inclusion, and have positive environmental benefits." However, STI solutions must be re-imagined to cater to society, including promoting solutions that are respectful of planetary boundaries.

The consensus in growth theory is that technology improves productivity and offsets the decreasing returns of capital, allowing the economy to obtain endogenous exponential growth (Perilla Jimenez, 2019). Schumpeter argued that the strength of economic growth lies in the key innovations that emerged regularly (Schumpeter, 1994; Lemanowicz, 2015). Schumpeter's (1994) notion of creative destruction is such that a new wave of innovation begins and destroys old institutional structures and replaces them with "effective conditions for an impending recovery cycle" (Lemanowicz, 2015). Fagerberg et al. (2010) argued that while an innovation system is a prerequisite for development, it is insufficient. Good governance and proper planning are essential.

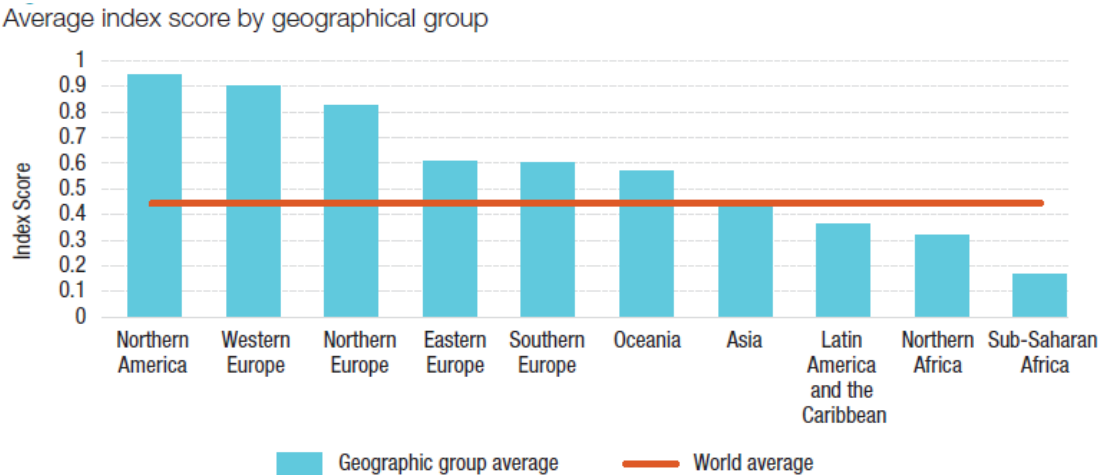
Other empirical studies like Benassi et al. (2020) found a link between STI and productivity at a firm level. Liao et al. (2018) observed that countries like the Netherlands include 4IR technologies in planning "to become fit for the future." Other countries identified the need to support economic growth and increase and maintain international competitiveness. Philbeck and Davis (2018) also argue that "the concept of 4IR affirms that technological change is a major driver of transformation relevant to all industries and parts of the society."

The Frontier Technology Index (FTI) used in this study to rank the four case study countries examines the capacities of countries to equitably use, adopt, and adapt frontier technologies, otherwise called the "readiness index" (UNCTAD, 2021). Based on their rankings,

countries are placed within one of four 25-percentile score groups: low, lower-middle, upper-middle, and high index values. Total scores range from 0 to 1, with a total score of 1 representing a country’s total rank of 1 based on 158 countries.

Fig. 2 shows that SSA is the region least ready to use, adopt or adapt to frontier technologies (Bobadoye, 2015) which can be attributed to a lack of holistic STI planning and constraints in other sectors. UNCTAD (2021) also argued that only a few countries currently create frontier technologies but must prepare for them.

**Fig. 2: Readiness toward the use, adoption, and adaptation of frontier technologies by geography**



Source: UNCTAD.

Most developing countries have STI policies that are incoherent with other development policies, which calls for the need to ensure that policies align with national development strategies while working towards the SDGs in industrial, agriculture, education and even health care (UNCTAD, 2017). STI policy should include the funding mechanism, tax incentives for adopting and adapting technology, creating clusters, providing training and business advisory (UNCTAD, 2021). Also, UNCTAD (2021) recommends that developing countries should align STI policies and industrial transformation through incubators, acceleration and innovation labs, promoting the

involvement of the private sector and civil society and ensuring people acquire the necessary digital skills to adopt and adapt to frontier technologies (UNCTAD, 2021).

Applying STI to the challenges of achieving the SDGs requires building local capacities, developing policies, and ensuring an enabling environment including adequate resource mobilization, partnership, and multilateral global collaboration, especially in R&D (UNCTAD, 2018). Researchers are developing methodologies to help ensure that the NDPs are aligned with the SDGs. Galsurkar et al. (2018) refined the United Nations Development Program's (UNDP) Rapid Integrated Assessment (RIA) which uses a natural language processing-based methodology for reviewing various NDPs to ensure that these plans align with the SDGs.

### **2.5.3 STI Policies and Covid-19**

UNCTAD's (2019) report highlights the importance of STIs in building a resilient society to better absorb and adapt to shocks. However, the pandemic has shown that there are gaps in national innovation systems, especially in developing countries that lack the capacity, research and development and technologies to produce and distribute vaccines. Nevertheless, STIs and Frontier technologies have played a role in understanding virus transmission and developing vaccines during the COVID-19 pandemic. For instance, AI and big data have been used to screen patients, monitor outbreaks, track and trace diseases, predict their evolution, and assess infection risks.

OECD (2021) provided evidence that digital tools and open data infrastructures have enabled scientists to continue functioning out of their laboratory or field environment, disrupted by the lockdown. The private sector has also delivered various innovative solutions to help cope with the emergency and enable employment opportunities for workers and other income-generating activities. The biopharmaceutical industry and academia have successfully completed several clinical trials for covid-19 drugs and vaccines. Emerging technologies in biology and

robotics have a role in tackling the pandemic and its impact. The pandemic has further buttressed STI policies' relevance to preparing and reacting to impending crises.

NDPs and STI policies need to be “reoriented to tackle the challenges of sustainability, inclusivity and resiliency” (UNCTAD, 2019). Research systems should be reformed to promote “transdisciplinary approaches needed to deal with complex, multifaceted problems.” Government R&D expenditures need to shift to reflect new priorities, such as the four SDG clusters (OECD, 2021). Other means to support STI policy reform are shown in Fig 5 below:

**Fig. 3:**



*Source: OECD (2021)*

## **2.6. Social, Political and Institutional Barriers to Gender Considerations in STI Planning**

Poonacha’s (2005) findings on the gender politics of STI policies in India relate to the disjuncture between policy statements and prevailing realities where “certain assumptions about class, caste or gender operate without being questioned.” The African Technology Policy Studies Network (Ozor et al., 2014) finding on gender mainstreaming of STI policies in Kenya showed

that STI remains skewed towards adult males, with women and girls underrepresented in all governance and policy-making processes.

UNCTAD recognizes some of the gender imbalance in S&T education, wherein in three out of four countries, boys/men are at an advantage and barriers for girls/women are inappropriate school environment, safety concerns, teaching methods that favour boys and varying levels of technical and vocational education (UNCTAD, 2011). In Africa, the public perception of STI is an “elitist and male subject” (Ozor et al., 2014). Norms also create a culture of exclusion for women, particularly in developing countries. For instance, women bear the enormous burden of domestic activities like water collection but are often excluded from water management decisions.

Female participation in STI policy-making is affected by cultural norms, traditions, male chauvinism and stereotypes. Stereotypes are acquired early; boys are perceived as smarter than girls, and boys are assumed to be better at mathematics (OECD, 2018). Gender stereotypes are socially and culturally embedded and resistant to simple policy actions. Some policy action reinforces these stereotypes, and there is a lack of adequate will to regender these policies (UNESCO, 2010). Most institutions lack women’s representation and the capability of women to assume certain positions in public office (Ozor et al., 2014).

Lee and Pollitzer’s (2016) study considers the gender bias where historically, technological advancements have benefitted men. For instance, the first speech recognition algorithm was developed by men and tailored to recognize men’s voices and the “market opportunity” of this innovation was lost because of gender neutrality. Another example is AI which perpetuates gender bias because of biased algorithms in the AI models, which creates “garbage in, garbage out” and reduces the benefits of these innovations for women and other equity-seeking groups (Catalyst, 2019).

Digital voice assistants like Apple’s “Siri” and Amazon’s “Alexa” are often designed with female names and voices, reinforcing the traditional notion of women’s roles as “administrative people.” This can have implications for the type of jobs women get hired for in the real world because they are assumed to fit “assistant type” jobs (Feast, 2019.). There are instances where computer vision systems reported high error rates for recognizing women, especially women of colour (Feast, 2019) and self-driving cars are less likely to see pedestrians who are dark-skinned.

In the podcast on “fighting systemic bias in AI,” Google’s AI director, Barak Turovsky, emphasized the skewed data around gender that impacts the level of bias in Google translation technology.<sup>4</sup> Most of these biases are traced to historical and societal issues. For instance, historically, doctors are assumed to be male, so “google translate” automatically assumes “male doctor” sounds more rational than “female doctor” (4 Ways to Address Gender Bias in AI, n.d.). Other examples include how car voice recognition reacts better to lower-pitched voices, and fitness trackers underestimate associated female activities like housework (UNCTAD, 2021).

Feast (2019) suggests that executives should ensure diversity in algorithm training samples, ensure the humans labelling these samples embrace diversity, encourage machine learning teams to measure accuracy levels by demographic categories and solve unfairness by collecting more training data. However, the nature of AI, particularly the social implication of gender and race bias, would require the mutual coexistence of the market and the government to ensure efficient allocation and equity through sound STI policies. Even with government intervention, these issues defy linear policy logic.

In scientific careers, Liani et al.’s (2020) study in sub-Saharan Africa also found that women’s lack of progression is shaped by the intersections between gender roles and social power

---

<sup>4</sup> See <https://www.youtube.com/watch?v=rV6aDI3rEW4>

relations within the family, the wider society and academic institutions. An analysis of individual decisions at the microlevel (social relations of gender in the family context), a mesolevel analysis of social power relations in the society and a macro level context of systems of patriarchy, capitalism, and neocolonialism are needed. This integrated conceptual framework can offer a starting point for policymakers to articulate gender into STI policies and NDPs.

Gurumurthy et al. (2016) applied a feminist lens to the “Digital India” policy agenda, the flagship program to transform India into a digitally empowered society and knowledge economy. They showed that the emergent technocratic regimes in India reinforce gender hierarchies. “The agenda of gender equality and digital empowerment is reduced to a neoliberal political rationality where the emphasis is on boosting international competitiveness uncoupled from structural justice issues” (Gurumurthy et al., 2016).

A programmatic analysis of the “African Women Forum on S&T (AWFST)” in Kenya showed that the program received less funding from donors than projects in health care or even climate change (Ozor et al., 2014). Also, the national sustainable development planning in the Caribbean showed that national women’s offices found their roles and capacities diminished due to lack of funding and “limited political” coverage (Hosein et al., 2020). Developing countries also have poor data collection and standardization culture, making monitoring and evaluating STI policies challenging. The lack of gender-disaggregated data undermines the assessment and response to the impact of social and economic vulnerabilities (Hosein et al., 2020).

Besides these constraints, the lack of representation of women in STI policy processes is also due to most women preferring not to participate in the leadership of research and innovation programs (UNESCO, 2010). Building the capacity of women and mainstreaming gender in policy formulation and implementation is crucial. STI policy-making should also involve a high-level

and broad public dialogue that creates synergies between public and private stakeholders, sectors, and civil society organizations (including women organizations) (UNCTAD, 2020).

## **2.7. Research Gaps**

The literature on NDP is evolving, and researchers have paid limited attention to gender considerations in STI policies. From an assessment of 126 major articles used in this MRP, there was no source on gender analysis of the “new” NDPs or STI policies. However, feminist scholars have focused on national planning, R&D, mobility of women in STI careers, and STI governance. A bibliometric search of databases showed that most of the work on gender in STI policies in the last decade was grey literature- UNCTAD, OECD, World Bank, and the UN. There is also the lack of a standard definition of a plan (what defines a long term, short term, medium, economic planning, national planning etc.). There is unsystematic evidence on whether a particular plan produces a specific outcome.

The literature (Lee & Pollitzer, 2016; Moser and Moser, 2005; Schmidt, 2005; Mainlay and Tan, 2012) on gender and planning conceptualized gender as binaries or women empowerment.<sup>5</sup> The UN Women was also silent on the meaning of gender.<sup>6</sup> Women were treated as a homogeneous group without a disaggregation of their differences in ethnicity, education, religion, race, or other social factors across these studies.

While this MRP cannot close all these gaps, its contribution to knowledge is that it uses a gendered approach to analyze STI policies and NDPs, which can set a basis for an enriched, balanced public discourse and consensus building in policy-making.

---

<sup>5</sup> See <https://www.unwomen.org/en/what-we-do/governance-and-national-planning/inclusive-national-planning..>

## **Chapter 3: Theoretical Framework and Methodology**

This section describes the theoretical frameworks and methodologies for analyzing the STI policy and STI sections of the NDPs of the four case study countries; The Bahamas, South Africa, Pakistan and the Republic of Congo.

### **3.1 Theoretical Framework**

This study is rooted in feminist institutionalism and the critical policy analysis approach otherwise coined by Bacchi (2009) as “what is the problem represented to be? Approach” (The WPR Approach).

#### **3.2.1 Feminist Institutionalism**

Feminist institutionalism captures themes like formal and informal institutions, structure and agency, power, institutional creation, continuity, and change (Mackay et al., 2010; Mackay and Krook, 2011; Chappel and Waylen, 2013). The feminist political science literature recognizes how institutions reproduce gender power distributions (Mackay et al., 2010). Mcphail (2003) contends that “all policy is gendered if we ask the questions that expose the gender assumptions and implications.” Chappel and Waylen (2013) also argue that actors who work with rules are gendered, whether as rule-makers, breakers, or shapers. Therefore, “if institutions are gendered, it is possible to “regender” them in ways that produce equality” (Mackay and Krook, 2011).

Chappel and Waylen (2013) examined the interactions between gendered formal and informal institutions.<sup>7</sup> This lens will help understand institutions’ origins, enforcements, and outcomes and why even “well-designed formal gender equality rules, such as efforts to increase the number of women in the public sector, often fail to produce their intended effects” (Rönblom

---

<sup>7</sup> Formal institutions involve written rules, such as laws and regulations while informal institutions emerge from socially communicated information and are part of a heritage called “culture” (Gimenez-Jimenez, et al., 2020).

and Keisu, 2013). For instance, “formal rules about the timing of meetings have gendered effects because of informal rules about women’s caring responsibilities” (Chappel and Waylen, 2013).

Gimenez-Jimenez et al. (2020) theorized that in entrepreneurship, the interaction of formal and informal institutions affects the likelihood of women becoming entrepreneurs, and policymakers need to consider the latter in policy design because informal norms can facilitate or hinder efforts to promote gender equality. Wajcman (1991) questions the flaw of studies that have only identified the structural barriers to women’s participation, including sex discrimination in employment and the kinds of socialization and education women receive. The approach risks identifying short-term solutions without asking the broader questions of how and in what ways science institutions and policies could be “reshaped” to accommodate women.

Rowe (2018) argued that feminist institutionalism and an intersectional approach to innovation policy considers the complex ways that labour, power, and institutions shape the language of innovation policy and the different impact on men and women. Therefore, a feminist institutional lens will help this study unpack and better explain the impact of gender blindness on STI policies. It will also help understand the formal aspects of gendered STI systems, as the state conceives them concerning gender, diversity and social inclusion (Rowe, 2018).

### **3.2.2 Feminist Critical Policy Analysis (FCPA)**

A framework connected to feminist institutionalism is the FCPA which describes the processes of articulating gender equality in policies, and this method has been used in several projects (Bacchi, 2009; Rönnblom and Keisu, 2013). McPhail offers a systematic model for an FCPA of national policies that covers the interconnectedness of gender, race, ethnicity and class. McPhail (2003) also shows the importance of context in analyzing policies where context could mean that attention must be paid to women's economic, political, and social realities.

The “issues of bias, power and values drive the identification and legitimation of a problem and methods used for solving it,” hence, Marshall (1999) calls to consider whether a policy will empower, democratize, or if it incorporates the needs of the “have nots,” which is considering traditional questions on whether a policy is efficient. FCPA calls for the need to develop “critical consciousness that would allow for the analysis and dismantling of patriarchy and privilege which would shift traditional notions of positions in the society” (Kanenberg et al., 2019). Ross (2015) expands on the gender framework by emphasizing the intersections and interconnection of orientations like gender, race, sex, social class, sexual orientation, age and religion.

The case studies of this MRP will focus on understanding how gender and gender equality are produced in STI policies and NDPs, how they are embedded in social, political and cultural dimensions, which according to Rönnblom and Keisu (2013), determine “how they produce an understanding of good or bad policy.” This framework will help understand how STI policies are constituted and given meaning and how subject positions or interests are produced.

## **3.2 Methodology**

### **3.2.1 Content Analysis**

This MRP selected South Africa and Pakistan's STI policies and the NDP of the Bahamas and Congo and subjected them to content analysis. The content analysis aims to “systematically transform a large amount of text into a highly organized and concise summary of key results.” The starting point is from the raw texts to the condensed meaning, code, categories and themes (Erlingsson and Brysiewicz, 2017). Qualitative content analysis has three approaches: directed, summative, and conventional content analysis; Table 2 below shows the differences in these approaches. (Hseih and Shanon, 2005).

#### **Table 2: Coding Difference between the Approaches of Content Analysis**

Type of Content Analysis	Study Starts With	Timing of defining codes or keywords	Source of codes or Keywords
Conventional content analysis	Observation	Codes are defined during data analysis	Codes are derived from data
Directed content analysis	Theory	Codes are defined before and during data analysis	Codes are derived from theory or relevant research findings
Summative content analysis	Keywords	Keywords are identified before and during data analysis	Keywords are derived from the interest of researchers or review of literature/theory/ relevant findings

Source: Hseih and Shanon (2005)

This study uses summative content analysis for specific word counts and comparison of keywords, followed by an interpretation of the underlying context of the STI policies and NDPs. It includes the normalization of word frequency using a common base of (10,000 words).

$$nf = (AC/TW) * nb$$

Where nf= normalization frequency, AC= Actual word count, TW= Total word count and nb= normalization base (See Appendix 1a and 1b for the data and computations).

Since this study takes a gendered approach that stresses the need to understand some subjective meaning and “language” of these plans, conventional analysis was used to interpret this language on whether the plans are gender-neutral or infer male dominance over other groups. Conventional content analysis was also incorporated to derive codes directly from the text data, and a directed content analysis was used starting with the theory and relevant findings from the literature review to guide the coding.

As a starting point for the coding, this study adapts Chimhowu et al.’s (2019) 10 thematic coding and 90 variables for reviewing NDPs. In addition, Mcphail’s (2003) feminist policy analysis framework, which provides a set of questions to ask during policy analysis, was used to augment Chimhowu et al.’s (2019) coding. Mcphail argues that even when trying to leave gender

out of the equation, the public policy creates and influences the perception of gender. Although Mcphail’s framework focuses on women, it offers a starting point for an intersectional approach by framing questions around themes for multiple identities. It also covers gender neutrality and power imbalances.

Specifically, this study considered forward-looking assessments and gender variables, bringing the total themes for this study to 14 (see table 3 below) and 94 variables (See Appendix 2). For ease of analysis and comparison of the case studies, these 14 themes were abridged into 6 (See “Centred Analysis” in Table 3 below). Theme 1 to 3 includes objective assessments such as analyzing the number of occurrences and observations, while themes 4 to 6 include subjective interpretations based on the literature and theories.

**Table 3: Themes**

S/N	Themes
1	Country
2	Plan Outlook
3	Data and Methodology
4	Evidence
5	Scenario snapshots
6	Links to Global Development Goals
7	Strategic Focus
8	Financing and means of implementation
9	Key Words
10	Multiple Identities and Gender Neutrality
11	Language and Equality of Rights
12	Power Analysis
13	Issues (Criteria*   Judgement*)
14	Plan Orientation

Centred Analysis	
Theme 1	Data and Methodology
Theme 2	Forward Looking Assessment
Theme 3	Financing and Performance Evaluation
Theme 4	Power and Gender Analysis
Theme 5	Scenarios and Evidence
Theme 6	Plan Orientation and Judgement

Theme 1 explores the type of data, assumptions and methodology used in these plans and the disaggregation by gender, ethnicity, socio-economic status, and urban or regional factors. Theme 2 considers how these plans include 4IR technologies, legal considerations like intellectual property (IP) rights, environmental considerations like climate change goals, and geopolitical and political factors. Theme 3 assesses the plans' funding and performance monitoring and evaluation.

Theme 4 assesses how gender is defined in the plans and if and how specific goals cover the needs of women and other equity-seeking groups. The Gender Diversity and Inclusion classification are based on the occurrence of these variables (normalized word frequency per 10,00 words) and the subjective assessment of the gender neutrality of the plans: where “1= Very Low Level,” “2= Low Level,” “3= Medium Level,” “4= high level,” and “5= high level”. Theme 5 covers scenarios and evidence criteria. Chimhowu et al. (2019) describe these criteria as a way to explore the extent to which the plans use relevant evidence base and propose several alternatives/scenarios: where “1=No use of scenarios; 2=Somewhat extensive use of at least two scenarios; 3 =Extensive use of, usually involving three or more scenarios.”

Theme 6 covers the plan orientation and judgement scale. Chimhowu et al. (2019) describe the plan orientation as to whether the plan is “technocratic (driven from the top by impartial experts), transformational or with elements of both. This scale includes how realistic, utopian or unrealistic the plan is, based on the level and type of assumptions, statistics and analysis used in the Plan. Where “1=Very unrealistic/utopian plan; 2= Somewhat unrealistic plan; 3=Plan with a mix of realistic and unrealistic aspects. 4 - Medium-to=high level of realism; 5=Highly realistic plan.” The functional classification of the plans based on Chimhowu et al.’s (2019) 2x2 matrix discussed in [Fig 1](#) was used to analyze the plan. Ultimately, an analysis of all the six themes in Table 3 above and the FTI (see explanation in [section 2.5.2](#)) was used for the final rank of the four case study countries.

### **3.2.2 Transforming the FTI Index**

This study transforms the FTI rank of the four case study countries to develop an overall rank. While the FTI provides insights into the extent of readiness of countries to adopt frontier technologies, it does not consider the gender variable. Therefore, in addition to the FTI rank (see section 2.5.2), this MRP uses the plan orientation, judgment scale and gender, diversity and

inclusion variables to derive the overall rank. A weight of 20%, 30% and 50% were assigned to these variables, respectively.

The judgment scale comprises the weighted average scores of evidence, assumptions, economic modelling, and scenarios variables ([See section 3.2.1](#)). The weights for these four criteria were assigned equally using the Microsoft Excel SUMPRODUCT function to determine the plan's judgement scale because it is hard to say that one of these criteria will supersede the other in determining the judgement scale (how realistic or unrealistic a plan is). The final rank for the judgement scale was derived using the Microsoft Excel RANK function of highest to lowest scores.

Gender, diversity and inclusion were assigned 50% weight because that is the main focus of this MRP, and the literature and theory have so far been used to justify the importance of applying a gendered lens to STI policies. As discussed above, the judgment scale represents multiple criteria, so it was assigned 30% weight, while the plan orientation was assigned the remaining 20%. Each of these scores was weighted using the Microsoft Excel SUMPRODUCT function to get the weighted scores, while the Microsoft Excel RANK function of highest to lowest scores was used for this MRP's final rank.

## Chapter 4: Case Study and Analysis

This section analyzes the NDPs and STIs of the four case studies: The Bahamas, Congo, Pakistan and South Africa. It also includes a focused comparison of the case studies and links to theory. All charts and analyses are the authors except otherwise stated.

### 4.1 Background and Plan Outlook

Table 4 below shows the countries' profiles and plan information. The countries were analyzed and presented alphabetically with consistent colour codes for the tables and charts. These countries have different naming conventions and frameworks for articulating STIs and NDPs. For instance, South Africa has an STI White Paper, Congo and Bahamas have NDPs that include STI issues, while Pakistan has a sectoral STI policy. The justification for analyzing and comparing these documents, regardless of their type, title, or duration, is that they contain an overall blueprint and strategic direction for achieving STI goals.

**Table 4: Country Information and Plan Outlook**

	Country Information				Plan Information					
Country	Population (In million)	GNI Category	HDI Category	Small Island State?	Year the Plan was launched	Type of Document	Title of Plan	Duration	Number of Pages	Total Word Count
Bahamas	0.38m	4=high-income economy	Very High=HDI of 0.800 or above	Yes	2016	National Development Plan (NDP)	National Development Plan of the Bahamas	2015-2040	631	138,023
The Republic of Congo	5.61m	2=Lower-middle- income economy	Low=HDI under 0.550	No	2012	National Development Plan (NDP)	Congo National Development Plan: Government Employment and Poverty Reduction Strategy	2012-2016	432	165,291
Pakistan	216.6m	2=Lower Middle- income economy	Medium=HDI between 0.550 and 0.699	No	2021	Science, Technology and Innovation Policy	Science, Technology and Innovation Policy 2021-2030	2021-2030	78	27,533
South Africa	59.3m	3=upper-middle- income economy	High=HDI between 0.700 and 0.799	No	2019	White Paper on Science, Technology and Innovation, 2019	White Paper on Science, Technology and Innovation	Not stated	88	39,421

The Bahamas embeds STI strategies in its NDP, and it covers the “Smart Bahamas Master Plan,” action statements, outputs and outcomes (pp. 18-19 & pp. 339-340). The Smart Bahamas Plan sets STI priorities linked to the NDP’s four pillars: human capital, economy, environment, and government (pp. 18). The plan incorporates ICT deployment, the development, use and interconnection of databases, and analytics and cybersecurity” (pp. 19). Before the new NDP, the Bahamas recorded progress in human capital, governance, infrastructure, and stable monetary policy (pp. 11). However, the challenges around the undiversified and underperforming economy, vulnerable natural and built environment and weak governance provided context for preparing the new NDP to achieve a more resilient and vibrant Bahamas that focuses on tourism, finance, education, and health, manufacturing and the private sector (pp. 12).

Congo does not have a publicly available S&T framework; hence this study reviews the NDP. The Congo NDP has its key components: Growth, Employment, and Poverty Reduction Strategy Paper (2012-2016 DSCERP), and it incorporates an STI-related vision for promoting S&T research toward sustainable development (pp. 36). The previous 2008-2010 Poverty Reduction Strategy Paper (PRSP) strengthened democracy and macroeconomic stability but had gaps in tackling unemployment, clean water, health, sanitation, education, and diversifying the economy, which provided the context for the new NDP (pp. 1-10). The new NDP seeks to strengthen industrialization and modernize Congolese society (pp. 12). The plan includes five pillars- governance, growth, infrastructure, social development and inclusion and sustainable development, covering agriculture, construction, mines, tourism, and the oil sectors (pp. 61-66).

Pakistan’s STI policy is in a separate document. “Since independence, Pakistan has formulated only two S&T policies, i.e. National STI Policy (1984) and National STI Policy (2012)” (pp. iv). The past STI implementation plans lacked funding and stakeholder buy-in, weak institutions and monitoring and evaluation (M&E) processes (pp. iv to viii). The new STI policy

articulates objectives for STI (pp. 1), including achieving the SDGs and promoting well-being and survival due to Covid-19 through early detection, response, drugs and vaccines (pp. 14-16). The plan covers agriculture, industry, trade, commerce, health, and education.

South Africa adopted a White Paper on STI in 2019 to build on the successes and overcome the weaknesses of the 1996 White Paper on S&T and the 2008 Ten-Year Innovation plan. These past plans achieved innovative performance, and the creation of new institutions, knowledge and capacities (pp. 12). However, several weaknesses around lack of inclusion, fragmentation of STI efforts, weak STI governance and the need to capture the 4IR technologies for economic growth set a basis for the 2019 White Paper (pp. 22-24). The White Paper seeks to enable inclusive and sustainable development, increase partnership, transform NSI institutions, and strengthen human capacities (pp. 10). It targets agriculture, mining, services and manufacturing sectors (pp. 26).

## **4.2 Focused Result Analysis**

### **4.2.1 The Bahamas**

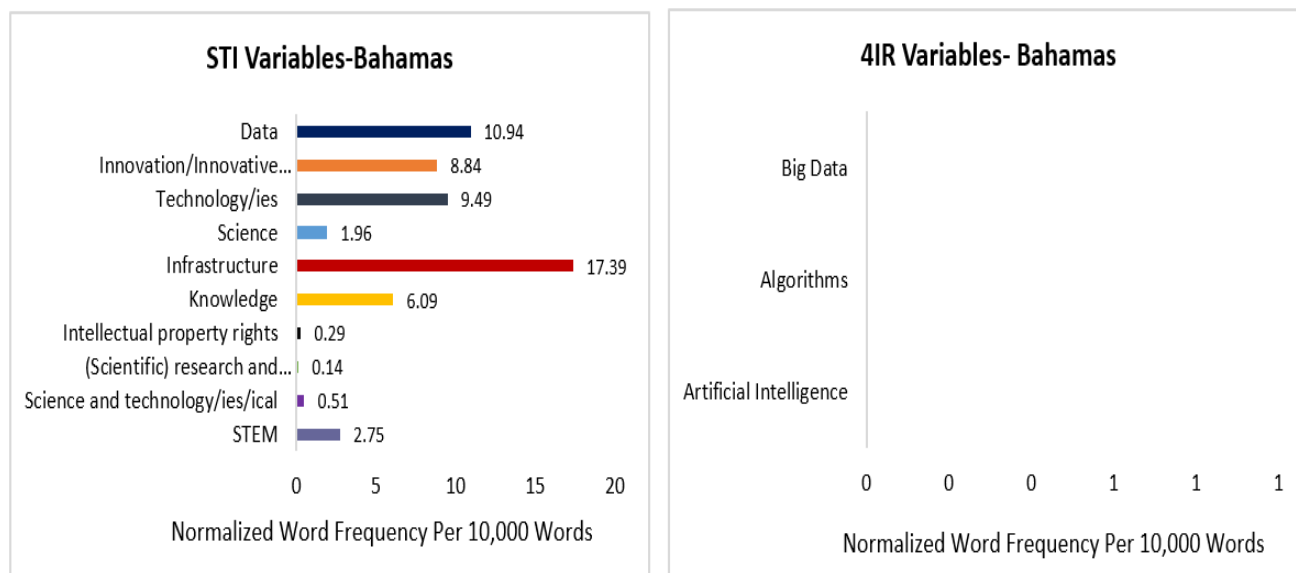
#### **Theme 1: Data and Methodology**

The SMART Bahamas goal includes developing, using, and interconnection of databases and analytics (pp. 339-340). The plan also used technology upgrades data for poverty mapping exercises (pp. 303-304 & pp. 503-504). There were outputs and outcome statements on enhancing data capacity and robustness in health care, education, and justice systems, including their gender disaggregation. For instance, e-health output includes “Infrastructure acquired to deliver telehealth, including databases for patient and doctor information...” (pp. 150). However, these data were not disaggregated by gender, ethnicity, socio-economic status, or urban or regional factors. The NDP does not state its methodologies or perform stress testing.

## Theme 2: Forward-Looking Assessment

Variables like infrastructure, data, technology, and innovation had relatively high occurrences per 10,000 words in the Bahamas NDP, but the plan does not include 4IR terminologies (Fig. 4). However, other open sources indicated the government’s plan to use smart technology with several pilot projects to transform education, health care, disaster management, and urban development.<sup>8</sup>

**Fig. 4: Bahamas’ STI and 4IR**



The forward-looking assessment also covers legal considerations. The NDP provided new legislation to protect intellectual property (IP) rights (pp. 446 & 544). The NDP included climate change goals and partnerships with leading green technology firms to build institutional capacity (pp. 30, 224, 580, & 589) and actions to reduce environmental damage, emissions and noise pollution (pp. 432). The plan also covered increasing the transparency of government decisions and accountability for government spending (pp. 27).

<sup>8</sup> <https://www.thebahamasinvestor.com/2017/bahamas-to-utilize-smart-technology/>

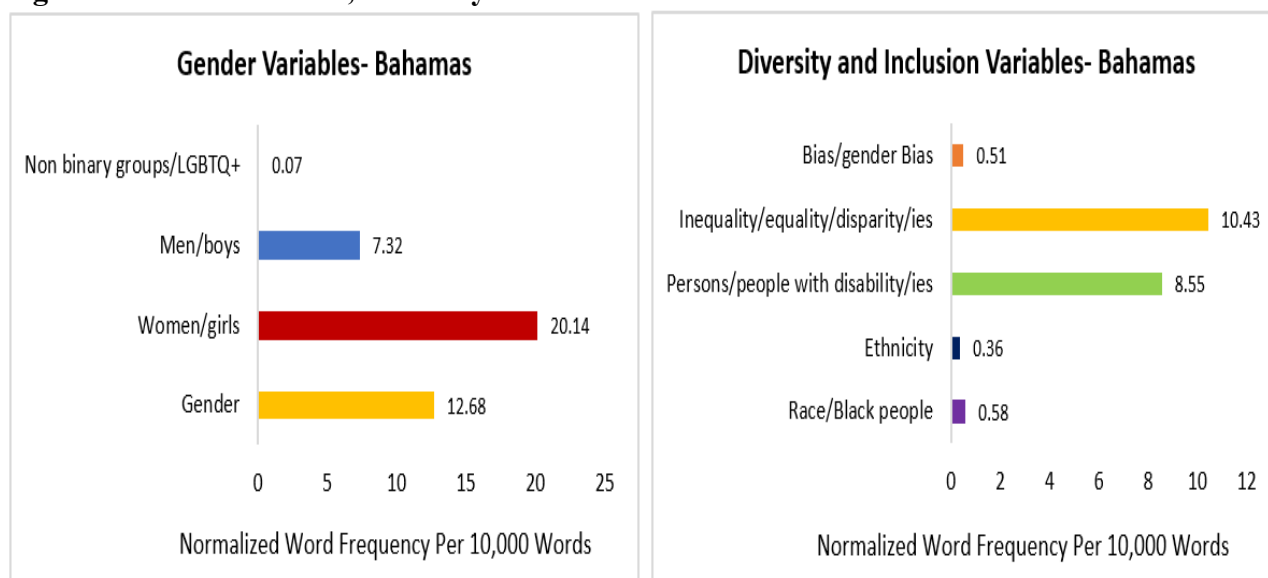
### Theme 3: Financing and Performance Evaluation

The overall financing mechanism for the plan was not stated. However, the private sector would play a role in funding educational development through bonds/instruments (pp.190) and direct investment in public utility services (pp. 332-333). The NDP goals (pp. 26-34) included a logic model that defined the inputs, outputs, outcomes, and indicators (pp 51-602). The Economic Development and Planning Unit (EDPU) and Public Policy Institute of the University of Bahamas will coordinate the M&E.<sup>9</sup>

### Theme 4: Power and Gender Analysis

The Bahamas NDP did not define “gender,” but it referred to men and women (fig. 5). In some instances, the plan referred to persons with disabilities (about 9 occurrences per 10,000 words) and one occurrence for LGBTQ, although terms like inequality and disparity had relatively high occurrences, which buttresses the government’s focus on SDG priorities. However, the government's strategic direction for women or other equity-seeking groups was not stated in the section on “the Smart Bahamas Plan” (pp. 15-16).

**Fig. 5: Bahamas’ Gender, Diversity and Inclusion**



<sup>9</sup> <https://observatorioplanificacion.cepal.org/en/plans/vision-2040-national-development-plan-bahamas>

Some goals and success indicators were specific to the needs of both men, women/girls and other equity-seeking groups, like “Increased availability of health information for everyone including women and girls” (pp. 159) and “equal career advancement opportunities for all women and men,” (pp. 536). However, others were biased and used languages that inferred male dominance and the invisibility of women and other equity-seeking groups. For instance, “teaching and education are relatively moderate paying professions with salaries averaging below \$31,000 (below-average salaries for the financial services sector). This creates a challenge in making the profession attractive for males” (pp. 191). The language here assumes that teaching salaries are too low to attract men, and it ignores if it fails to attract women and other equity-seeking groups.

### **Theme 5: Scenarios and Evidence**

The Bahamas NDP includes goals and targets around achieving the SDGs (pp. 13-15), and it targets New Growth Sectors (pp. 502-530). However, the underlying assumptions and economic modelling were not stated. The plan’s level of evidence is “medium” ([see section 3.2.1](#)) based on its scenarios and current state analysis (pp. 9-12).

### **Theme 6: Plan Orientation (Typology) and Judgement**

The Bahamas’ NDP orientation is “technocratic and transformative-” technicians, sector experts, and the Bahamian public contributed to making the plan (PP. M). The NDP is Type B based on Chimhowu et al.’s (2019) functional classifications ([see fig. 1](#)),<sup>10</sup> except that the plan has weak evidence. The overall judgement scale of the plan is “Somewhat unrealistic” based on the evidence, assumptions, economic modelling and gender blindness ([see section 3.2.1](#)). Other limitations, including the lack of a clear funding mechanism, make resilience towards future pandemics bleak, and the lack of updates that sets the direction of STI to tackle Covid-19 makes the current plan “Very unrealistic/utopian.”

---

<sup>10</sup> Type B- “Largely bottom-up process, communicative rationality, strong evidence base, social embeddedness”

## 4.2.2 The Republic of Congo

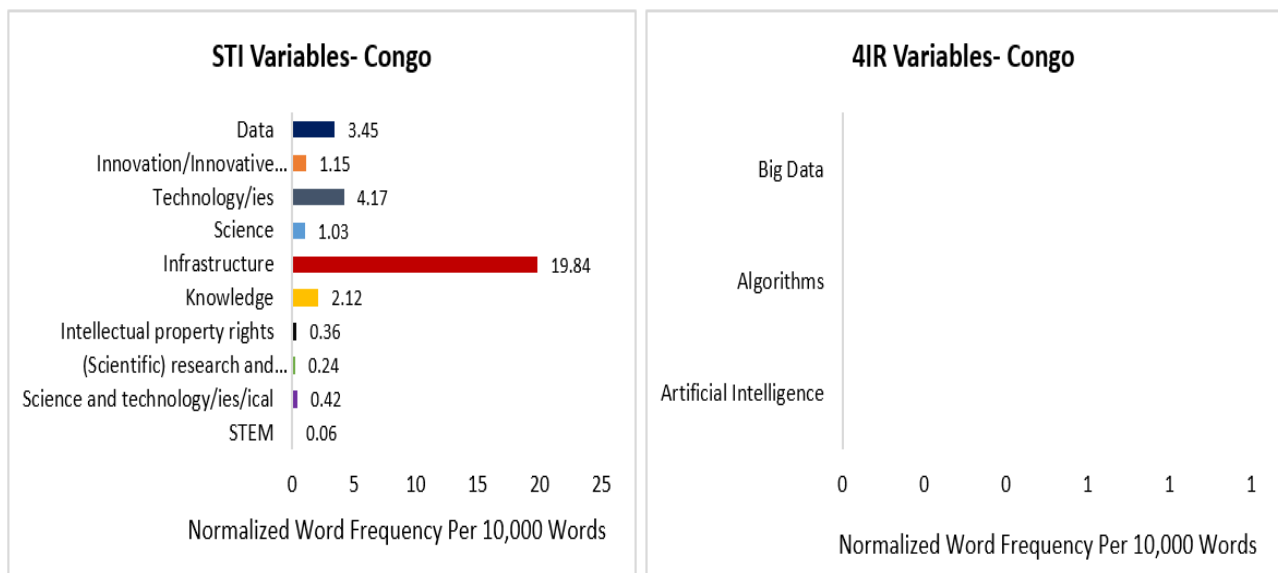
### Theme 1: Data and Methodology

The Congo NDP analyzed macroeconomic indicators like household income (pp. 121) and other social services: education, health and transportation (pp. 330 & 354). The plan also used data on the rate of energy loss, electricity, ICT, internet subscribers, telephone users, railroads, and natural gas to provide evidence (pp. 148). However, these data were not disaggregated by gender, ethnicity, socio-economic status, or urban or regional factors.

### Theme 2: Forward-Looking Assessment

The plan does not include any goal related to the 4IR or other emerging technologies (Fig. 6). Infrastructure had the most occurrences- 20 per 10,000 words, and there was no 4IR terminology in the plan. Although the government announced in December 2014 that it was contributing \$400,000 to enable UNESCO to reinforce Congo's capacity in STI, hoping to make research and innovation active contributors to development. However, there is no publicly available evidence for evaluating the impact of these efforts.

**Fig. 6: Congo's STI and 4IR**



Other areas of the forward-looking assessment include the NDP's consideration for IP rights in agriculture and forestry (pp. 37, 133 & 307), but there was no funding for this IP program or the awareness, education to promote a successful IP system. The NDP integrates some of its goals and indicators with gender segmentation (pp. 332-335). The plan also considers the impact on the environment and climate change from key activities like transportation and sustainable land and mineral resources conservation (pp. 342-343). However, other geopolitical and political considerations were absent from the plan, such as the shift in the world's economic and geopolitical power, the increasingly multipolar international landscape, and how global STI trends can impact Congo if it imports these technologies or STI capacities.

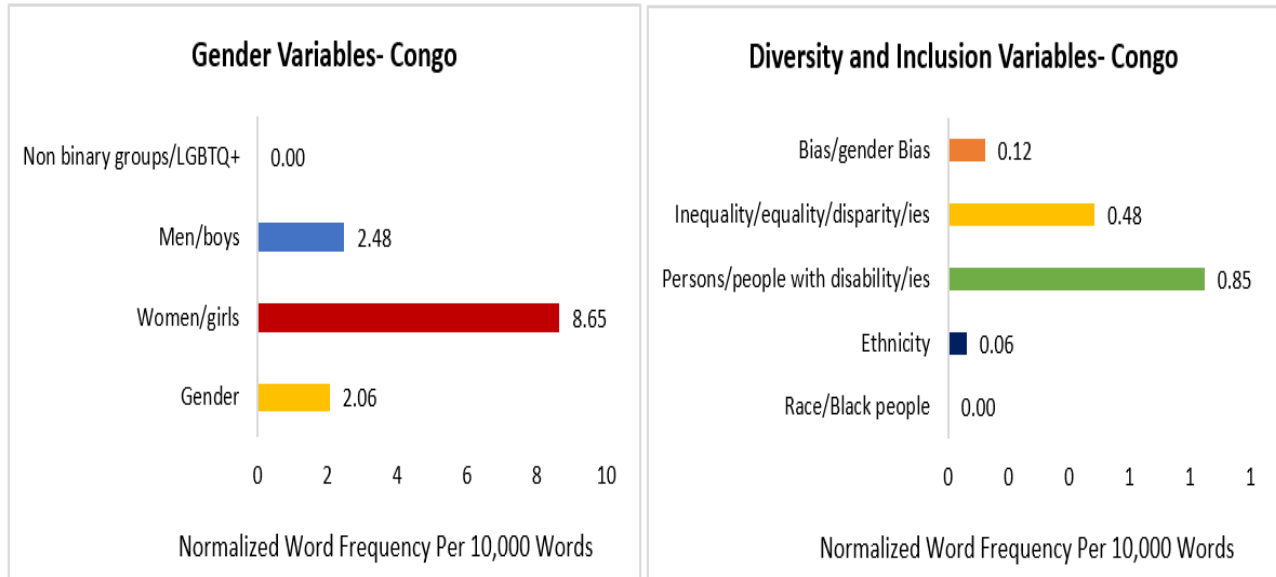
### **Theme 3: Financing and Performance Evaluation**

The plan's estimated cost is 13,000 billion CFA (Estimated at USD 21.5 billion), split about 70:30 between the public and private sectors (pp. 52). The plan also covered the institutional framework for M&E, its methodologies, objectives, missions and expected outcomes (pp. 389-393). The M&E will be managed by the Committee for Monitoring and Evaluating Public Programs and Policies and the National Poverty Reduction Committee (CNLP), presided over by the Minister of Economic Planning (pp. 389).

### **Theme 4: Power and Gender Analysis**

Gender was not explicitly defined but is referred to as men and women (fig. 7). However, the plan addresses the needs of persons with disabilities through sign languages, literacy programs, and early detection and treatment of disabilities (pp. 333). The NDP covers issues of female empowerment and accounts for the gaps in women's economic, social, and political status (pp. 334). All the STI-specific goals and indicators, except for health data (pp. 333, 358, & 406), were gender blind, which risks having initiatives or programs that assume that men, women, and other equity-seeking groups face the same issues.

**Fig. 7: Congo's Gender, Diversity and Inclusion**



### **Theme 5: Scenarios and Evidence**

The plan includes goals and targets for achieving the MDGs, and it has not been updated to include the SDG targets (pp. 3). It extends the MDGs to sectors like Agriculture, Forestry, Public Works & Construction, Mines, Oil, Tourism, Financial Services, and Social sectors (pp. 40-41). It also provided extensive evidence, assumptions and economic modelling- “Macroeconomic and Budget Framework Model (MTEF MCMB-RC-Central)” (pp. 353), but these models and assumptions were unrelated to STI.

### **Theme 6: Plan Orientation (Typology) and Judgement**

The Congo NDP is “technocratic” and has a “Type A functional classification” ([see fig. 1](#)).<sup>11</sup> Although the Congo NDP included a key strategic focus and is quite robust in terms of evidence, assumption, and economic modelling, its gender blindness and unclear IP framework make it “Somewhat unrealistic” ([see section 3.2.1](#)). The absence of emerging technologies, updates on the SDGs, specific measures, programs and funding to tackle Covid-19 and future pandemics makes the plan “Very unrealistic/utopian.”

<sup>11</sup> Type A- “Largely top-down process, rational blueprint, strong evidence base and limited social embeddedness”

### 4.2.3 Pakistan

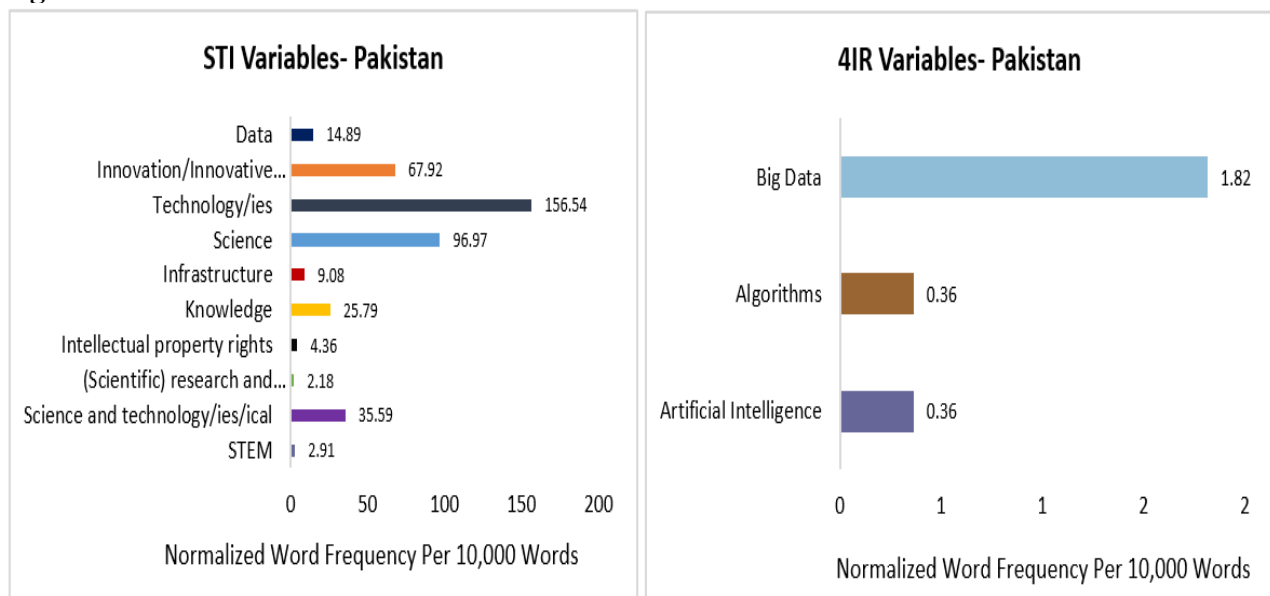
#### Theme 1: Data and Methodology

The Pakistan Council for Science and Technology is responsible for collecting, updating, and maintaining national STI statistical indicators (pp. 9). While the term “data” had about 15 occurrences per 10,000 words (fig. 8), they were around strengthening data collection and analysis (pp. 21 & 25), but actual statistical data to drive indicators and impact were few. However, there were few data on male and female participation in various S&T fields and education (pp. 36), but other data were not disaggregated by gender, ethnicity, socio-economic status, or urban or regional factors. The NDP does not state its assumptions and methodologies or perform stress testing.

#### Theme 2: Forward-Looking Assessments

The Pakistan STI policy incorporates STI and some 4IR terms. Technology had about 157 occurrences per 10,000 words, and innovation, science and knowledge had relatively high occurrences (Fig. 8). The STI policy includes objectives around “Adopting a 21st-century approach to STI governance and management” and “focusing emerging and frontier technologies to achieve national socio-economic development goals” (pp. 1).

**Fig. 8: Pakistan’s STI and 4IR**



Other strategic focuses like Legal include creating awareness for all stakeholders regarding the importance of IP rights (pg. v). However, there is a lack of capacity and strong institutions to enforce these IP rights (pp. 5). The policy aims to enhance the annual national R&D spending as a percentage of GDP (pp.7). The policy also addresses the effort of the government to utilize scientific advice to achieve foreign policy objectives such as climate change and international treaties on the ocean (pp. 62).

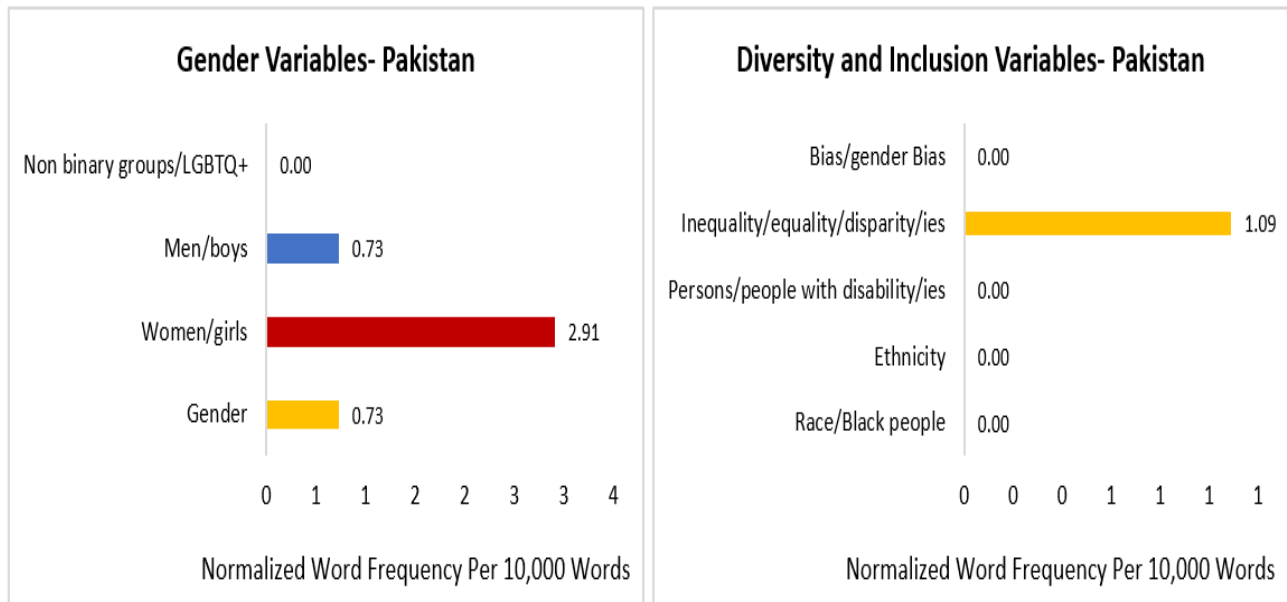
### **Theme 3: Financing and Performance Evaluation**

The STI policy does not state the agencies or stakeholders responsible for M&E or the funding model. The government is the key driver of the Pakistan STI policy. The 65 research and development organizations with more than 250 sub-organizations in Pakistan are public sector-led (pp. 2). The private sector operates under strict public sector regulations, innovation, and limited capacities (pp. 4).

### **Theme 4: Power and Gender Analysis**

Gender was barely used in the STI policy, but women and men were mentioned (Fig. 9), and virtually all the variables in Fig. 14 had zero or at most 3 occurrences per 10,000 words. The STI policy has 58 statements on enhancing the role of STI in Pakistan's development (pp. 20-65), and only one of these statements (statement 26) directly speaks to women's needs. "Women will be encouraged to participate in S&T at all levels of education and supported to opt for scientific research careers" (pp. 36), but there are no indicators to evaluate the success of this goal.

**Fig. 9: Pakistan’s Gender, Diversity and Inclusion**



The STI policy goals use terms like “scientists,” “Researcher,” “workers,” “executives,” and “Entrepreneurs” without disaggregating the data or indicators by gender or ethnicity (pp. 35). The policy does not provide any evidence of the involvement of women and other equity-seeking group stakeholders or partners in the policy process.

**Theme 5: Scenarios and Evidence**

The policy included goals and targets around achieving the SDGs (pp. 13) and using STI to support other sectors of the economy (pp. 10). It also identifies STI for Covid-19: “Enhance readiness level through taking appropriate STI policy measures to develop capacity for early detection, response, and control of the diseases as well as for production of drugs and vaccines” (pp.14), but it is not clear how the plan will achieve these goals. For instance, there is no transparent funding, and Pakistan has limited internet access to foster education or improve health, yet the policy does not state what will be done going forward to ensure every household has access to efficient and affordable ICT infrastructures. There is no evidence used in the policy; neither were the underlying assumptions and economic modelling stated.

## **Theme 6: Plan Orientation (Typology) and Judgement**

The Pakistan STI policy is “technocratic.” The functional classification is “Type C” ([see fig. 1](#)). The lack of evidence, assumptions, and economic modelling, coupled with gender blindness, makes it “Very unrealistic/utopian” ([see section 3.2.1](#)). Despite being a sectoral plan and holding the potential for using STIs to transform various sectors of the economy, coupled with identifying how the COVID-19 pandemic impacts education, health, and STIs’ role in enhancing resilience, the lack of clear funding and heavy control of the government makes the policy weak.

### **4.2.4 South Africa**

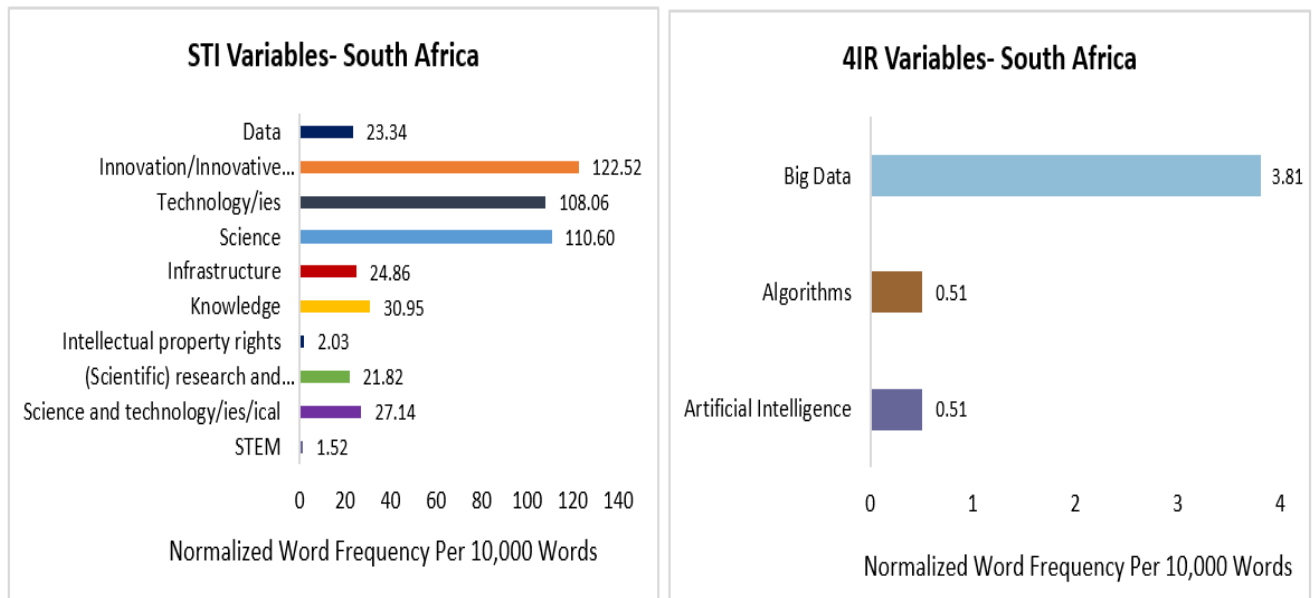
#### **Theme 1: Data and Methodology**

The South Africa White Paper used data to analyze historical economic trends (pp. 46). However, the plan does not explicitly state the types of methodologies used to analyze or evaluate the plan’s objectives, nor does the plan contain stress tests or scenario analysis. The White Paper disaggregates data on Ph.D. enrolment (pp. 8) and researchers (pp. 44) by gender and race; however, data and assumptions around transport, access to ICT, and energy consumption were not segmented by gender, race, ethnicity, age, socio-economic status, rural-urban/regional factors.

#### **Theme 2: Forward-Looking Assessment**

STI and 4IR terms had relatively high occurrences, and big data had the most occurrences for 4IR variables- about 4 occurrences per 10,000 words (Fig. 10). The occurrences of STI terms, particularly 4IRs, indicate that South Africa places value on predictive and advanced analytics to generate insights on policy and programs.

**Fig. 10: South Africa's STI and 4IR Technologies**



The White Paper includes legal consideration through enabling legislative framework for IP rights and established access mechanisms for formal IP registration (pp. 22). It considered the need for R&D and innovation in sectors that directly impact GDP, like funding incremental and radical technology to enhance the local manufacturing sector (pp. 41). The White Paper addressed the need to expand STI capabilities, including research competence and skills to support national development priorities in environmental risks: climate change, drought and loss of biodiversity (pp. 2). It also included geopolitical, national, and global drivers of change and recognizes the shift in the world's economic and geopolitical power from west and north, creating opportunities for Africa to become global leaders in STI research (pp. 15).

### **Theme 3: Financing and Performance Evaluation**

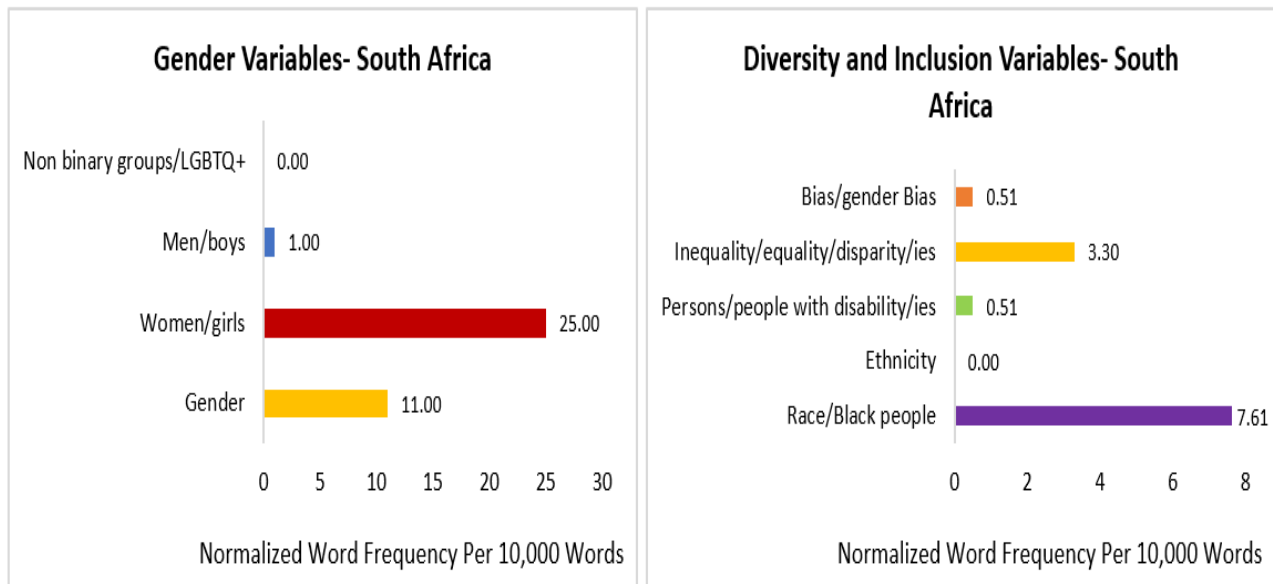
The cost of implementation was not stated, probably because it is a White Paper, and the actual costs will be in the ten-year decadal plans (pp i-iii). The White Paper proposes that the decadal plans will detail technology focus areas, programmes to be initiated, institutional arrangements and funding required for these programmes (pp. x). The White Paper included a private-public sector funding model that involves a sovereign innovation fund, but it was silent on

the role of civil society (pp. 65). It also addressed enhancing M&E's capacity for regular foresight exercises, chaired by the Minister of Science and Technology (pp. 27).

**Theme 4: Power and Gender Analysis**

Gender was not explicitly defined in the policy, but it was used to refer to men and women (fig. 11). The White Paper integrates gender-equity performance with race and historically disadvantaged groups by segmenting STI professionals and accounting for gender disparities in STI research (pp. 44). Also, the Minister and Deputy Minister of the Department of Science and Technology are women, but the role of other equity-seeking groups in the White paper is unclear (pp i-iii).

**Fig. 11: South Africa’s Gender, Diversity and Inclusion**



Although fig. 11 shows that relatively the White Paper recorded high occurrences for terms like “women” and “race/black people,” the White Paper is mainly gender-neutral. It uses generic language like “Scientists,” “Researchers,” or “professionals” without a clear blueprint on how the goals, indicators, budget/funding will be disaggregated by gender. Asides from goals around increasing the number of women in academic STI research (pp. 34), other areas of 4IR like

advances in ICT, the Internet of Things, big data, artificial intelligence-based systems and additive manufacturing were gender-neutral.

### **Theme 5: Scenarios and Evidence**

The White Paper includes goals and targets for R&D, skills and development, and the labour market, but the plan's underlying assumptions and economic modelling were not stated. The plan's level of evidence is "medium," and it mentions the SDGs, but SA faces social issues, including crime, poverty, inequality, and food insecurity, and the White Paper does not clearly state how STI will tackle the root causes of inequality (Andoh, 2019).

### **Theme 6: Plan Orientation (Typology) and Judgement**

The plan orientation is technocratic and "Type A" functional classification ([see fig. 1](#)).<sup>12</sup> There is no evidence that South Africans or residents were consulted in drafting the White Paper. Given the lack of evidence, funding, assumptions, and insufficient data, the overall judgment scale is a "plan with realistic and unrealistic aspects" ([see section 3.2.1](#)). Independent analysis also shows that with the aftermath of the Covid 19 pandemic and the pre-pandemic economic recessions, the hopes for meeting the broader NDP and SDG targets are bleak.<sup>13</sup> Therefore, considering pandemic resilience, the White Paper is "Very unrealistic/utopian."

## **4.3 Focused Countries Comparison**

SA and Pakistan have similar characteristics regarding their population sizes, and they both have separate STI policies. Conversely, the Bahamas and Congo are relatively small countries, and they both incorporated their STI goals in their NDPs. Therefore, comparing countries with similar plans and relative population sizes is more appropriate.

---

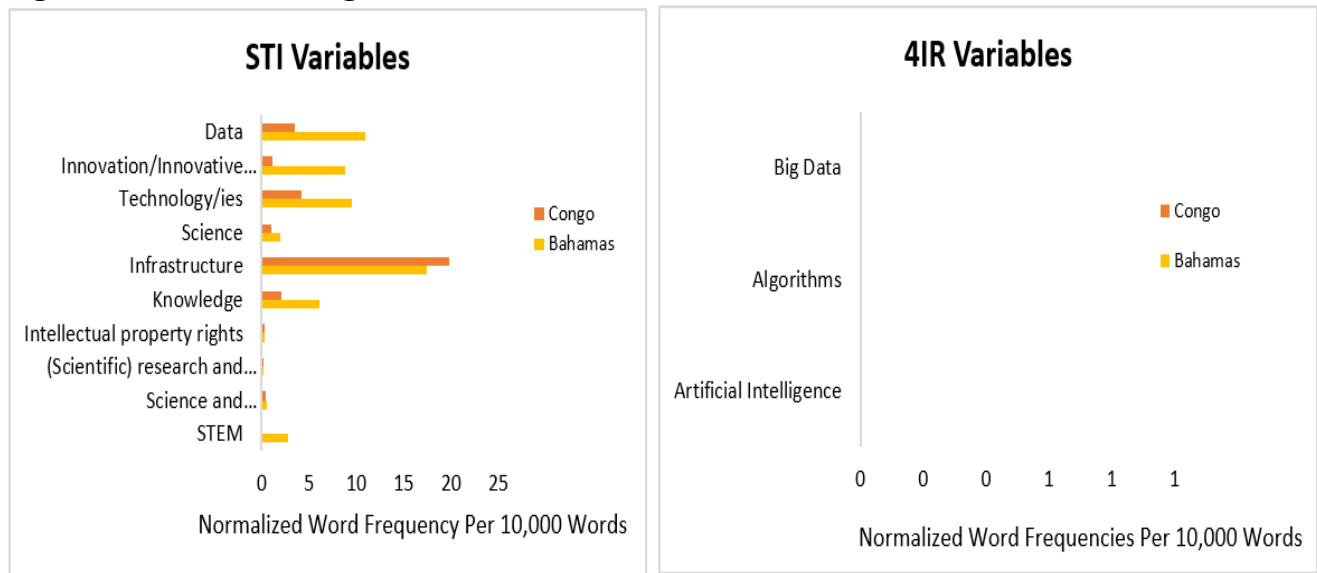
<sup>12</sup> Type A- "Largely top-down process, rational blueprint, strong evidence base, and limited social embeddedness"

<sup>13</sup><https://www.dst.gov.za/images/2021/Higher%20Education,%20Science,%20Technology%20and%20Innovation%20Institutional%20Landscape%20Review%20Report.pdf>

### 4.3.1 Focused Comparison 1: Bahamas Vs Congo

Fig. 12 shows that both Bahamas and Congo did not include 4IR terms in their plans. Across all the STI-related variables, the Bahamas had high occurrences per 1,000 words compared to Congo. Terms like “intellectual property,” “scientific research,” and “STEM” had low occurrences in both countries’ plans. Congo did not have any words related to STEM, while the Bahamas identified various strategies to promote STEM, the links to SDG 4 (quality education), SDG 5 (gender equality) (pp. 206), including the outcomes, time frame and responsible agency (pp. 207). While the Bahamas recognized the need for “new legislation on IP” (pp. 446), the outcome statement to measure success is not clear. Also, Congo’s NDP did not have any specific action for IP (pp. 133 & 307).

**Fig.12: Bahamas Vs Congo- STI and 4IR**

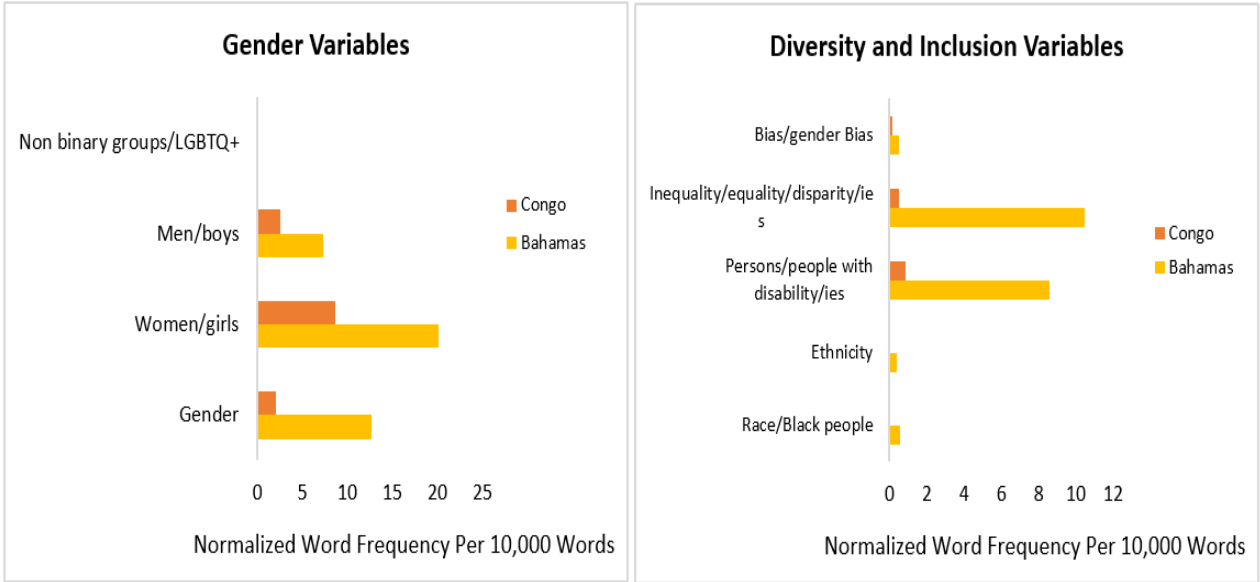


The lack of 4IR terms could be because the Bahamas, although a high-income country, has a small population (approx. 0.38m) and Congo, a low-HDI country with a population (approx. 5.6m). There could be limited specialist staff and financial resources to draft standalone plans that focus on 4IR technologies compared to a high-income country with a larger population. Therefore,

the Bahamas and Congo may prioritize strengthening domestic capacities in the earlier generation or import 4IR technologies and services.

Based on the occurrence of the terms, Fig. 13 shows that the Bahamas places more importance on equity, persons with disability, gender and women than Congo. Congo, a developing country, grapples with broader economic and political issues, which could be why gender equality was not important.

**Fig.13: Bahamas Vs Congo- Gender, Diversity and Inclusion**



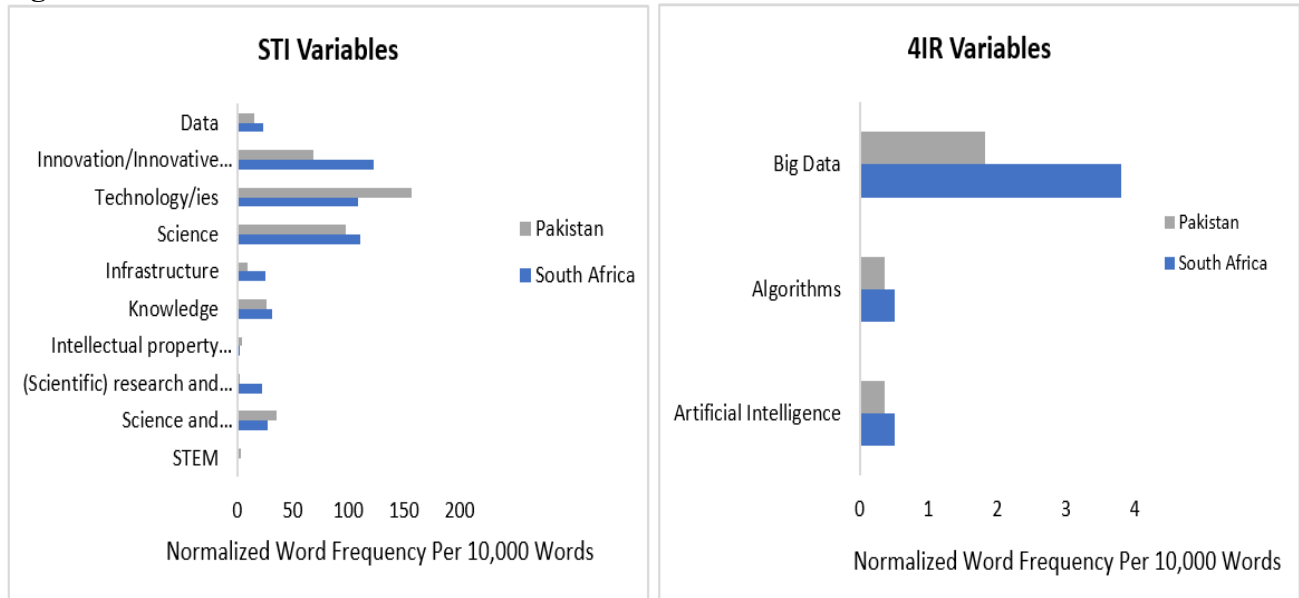
**4.3.2 Focused Comparison 2: Pakistan Vs South Africa**

Fig. 14 shows that Pakistan and South Africa's STI policies include STI and 4IR terms, but SA has a robust White Paper based on these terms' relatively high occurrence. The size of both countries and HDI (medium and high) respectively could mean that they have the resources- people and financial to include investment in 4IR in different frameworks.

South Africa was able to create an independent office, “National Intellectual Property Management Office (NIPMO)” (pp. 22), that will govern the IP process, and it had a clear policy intent- “promoting access” (pp. 33), but the funding and outcome measures for IP were absent.

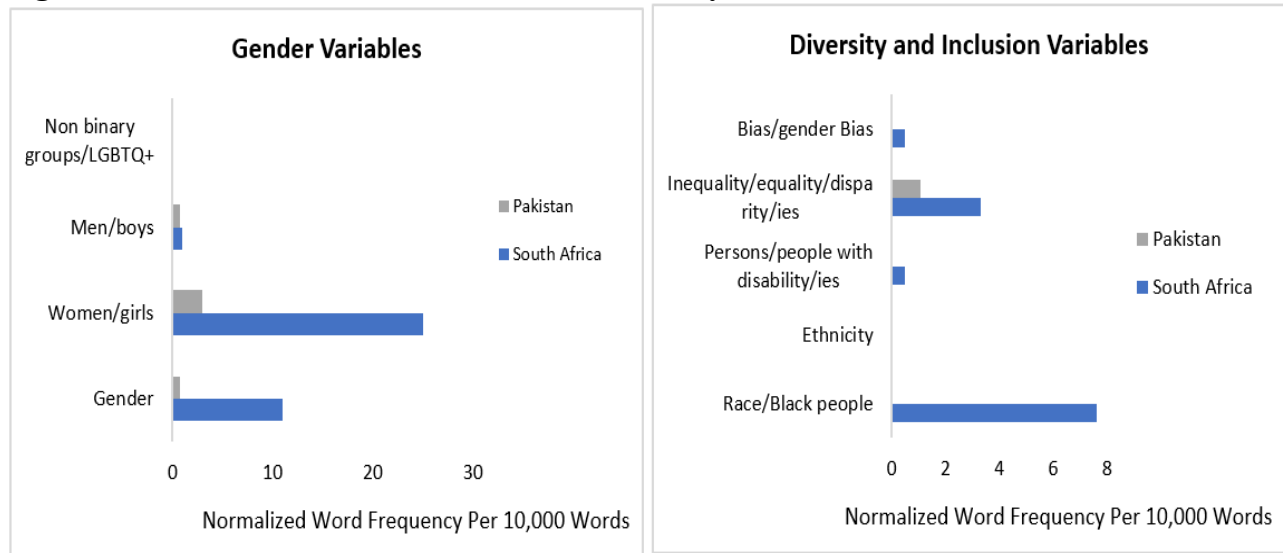
Also, Pakistan recognizes a robust IP rights system to protect innovation and promote commercialization (pp. 39), but it also lacks clear funding and a stable institution that will drive this system.

**Fig. 14: Pakistan Vs South Africa- STI and 4IR**



South Africa’s White Paper mentioned STEM six times (Fig. 14), and one of the major policy emphasis in the White Paper includes “Improving educational outcomes, from early childhood through to tertiary education, with a focus on STEM skills” (pp 69), but lacked gender specificity. However, Pakistan's STI policy had eight occurrences of STEM and even recognized the problem of low female enrolment in STEM (pp. 36) and a policy to promote women’s participation in STEM (pp. 37), but it is not clear which metric will be used to evaluate success.

**Fig. 15: Pakistan Vs South Africa- Gender, Diversity and Inclusion**



Pakistan’s STI policy had low gender, diversity, and inclusion terms than South Africa White Paper (Fig 15). In principle, Pakistan runs a democratic parliamentary system of government like South Africa, and the expectation would be to have a progressive gender equality system that cuts across the economy. Although Inglehart et al. (2002) argued that support for gender equality is not just a consequence of democracy but “the norm of gender equality is intimately involved in democratization.” Iman (2021) critiqued the quality of Pakistan’s democracy as less functioning, and the abuse of women’s rights is linked to the history of military dictatorship, religion and culture, which reflects through Pakistan’s STI policy.

### 4.3.3 Key Gaps across all the Plans and Links to the Literature

All the STI policies and NDPs were mainly technocratic and top-down driven except the Bahamas, which is both technocratic and transformative. While both South Africa’s White Paper and Pakistan’s STI policy included STI and 4IR terms, after assessing the data, evidence, assumptions, counts of terms and subjective assessment of gender and inclusion, South Africa’s White Paper is more robust and progressive than the STI sections of the Bahamas and Congo NDPs and Pakistan’s STI policy.

Only Congo included the means of funding its plan's implementation, and it is hard to prove if this is even sufficient. All the plans face the challenge of heavy dependence on the government for funding, little appetite for innovation in the private sector (very few high techs and quality products are produced), and a lack of collaboration among institutions and stakeholders' buy-in. They also lacked a clear IP framework for protecting and commercializing technology. Other gaps across the plans include a lack of a monitoring and evaluation system. These findings are consistent with the findings in the STI literature on gaps in developing countries, including lack of funding and lack of coordination and collaboration (Yongabo and Goransson, 2020; Ozor et al., 2014 & Bobadoye, 2015).

Only the South Africa White Paper addressed the ethical issues and bias around STI through a National Science Innovation (NSI) gender framework. UNCTAD (2021) argued that technologies can amplify systemic bias and discrimination, especially new digital divides between the “technology haves and have-nots” during COVID-19, underscoring the importance of having a national framework covering these issues.

All the plans referred to Gender as “men” and “women,” but based on the findings from the literature, gender identity is not confined to a binary or static, and the definition of gender impacts how it is considered in policies. Pakistan barely used the word gender, and Congo did not have gender STI goals, while the Bahamas had a direct male preference on some goals. All the plans used gender-neutral terms without specific gender-related targets, data, or indicators which risks reinforcing stereotypes, especially in countries that are less gender progressive and stereotypes around who scientists or researchers are predominantly male (OECD, 2018). Lee and Pollitzer's (2016) findings show the need for innovation systems to take a “gendered innovation” approach to achieve socio-economic growth.

The social, political, cultural and historical factors that impact gender were also not explicit in these plans, except South Africa White Paper that considered apartheid's implications and how it impacts black women benefitting from STI. Rönnblom and Keisu's (2013) findings on how these issues can produce an understanding of what is "good" and "bad" policy provides further insights into the implication of gender blindness and the lack of cultural and historical consideration in these plans.

Three of the plans did not indicate the role of women civil society organizations, other equity-seeking groups, and citizens/residents, and South Africa was the exception. This weakness provides insight into the literature on planning based on Agarwala's (1983) argument that countries that performed best were not those with a high degree of planning efforts but streamlined coordination and consultation within private, public sectors and civil societies rather than top-down technical expertise. Also, Manyena (2013) called for post-colonial states to integrate NDPs into a single participatory framework through civil organizations and champions of change that will serve as "watchdogs" to preserve the democratic approach of the planning process.

#### **4.3.4 Theoretical Explanation of Results**

As discussed in chapter 3, feminist institutionalism covers the impact of gendered formal and informal institutions. Only South Africa's White Paper recognized civil society as a potential link between innovation systems' formal and informal parts. The South Africa White Paper identified barriers for women to benefit from the STI process. The South Africa White Paper also articulated the role of civil society to strengthen and incentivize collaboration with publicly funded R&D institutions and science councils to promote the interest of black women and mentor them to take up senior management positions in research and science institutions (pp. 48). Conversely, the Bahamas and Congo's NDP and Pakistan's STI policy did not cover the barriers around informal

rules: social and cultural, including family responsibilities, customary rules and institutional constraints that hinder women and other equity-seeking groups from participating and benefitting in the STI process.

Feminist institutionalism is also related to representation, where descriptive representation is based on the head-count of women in institutions, and substantive representation accounts for meaningful representation in enforcing change, or the heterogeneity of women based on race, disabilities, sexual orientation, or religion. For instance, the Bahamas NDP Steering committee consisted of 19 members, with only 4 women (pp. F to M). On the other hand, the NDP secretariat had 10 members with 7 women. However, the main contributors and shapers of the NDP were the steering committee, while the secretariat, where women constituted 70%, performed the administrative role, which speaks to the need for policy to shift emphasis from descriptive to substantive representation.

#### **4.3.5 Overall Rank**

Based on the FTI rank (see Table 5), South Africa ranked higher than the other three countries across all the categories except for R&D, where Pakistan ranked highest, and Congo ranked the least overall across all the dimensions (ICT, skills, R&D, industry and finance) (UNCTAD, 2021). The FTI scores of these four countries are consistent with Bobadoye's (2015) finding that developing countries, especially in sub-Saharan Africa, are the region least ready to use, adopt or adapt to frontier technologies, which can be attributed to a lack of holistic STI planning and constraints in other sectors.

**Table 5: Readiness for Frontier Technology Index Ranking**

Country Name	Total Score	Total Ranking	Score group	ICT Ranking	Skills Ranking	R&D Ranking	Industry Ranking	Finance Ranking
Bahamas	0.39	84	Lower-Middle	37	73	143	126	74
The Republic of Congo	0.13	135	Low	157	125	122	80	136
Pakistan	0.2	123	Low	145	146	60	96	132
South Africa	0.55	54	Upper-Middle	83	58	94	74	40

Source: UNCTAD (2021)

As discussed, since the FTI rank does not consider the gender variable, which is the main focus of this MRP, this study uses the FTI rank, plan orientation, judgment scale and gender, diversity and inclusion variables as shown in columns E to F of table 6 below to derive the overall rank. Table 6 summarizes the classification of the plans based on the multiple criteria analyzed like evidence, economic modelling, assumptions, plan orientation, scenarios, gender, diversity and inclusion and judgement scale ([see section 3.2.1](#)).

**Table 6: Summary of Plans Classifications**

Countries	Evidence (A)	Assumptions (B)	Economic Modelling (C)	Scenarios (D)	Plan-Orientation (E)	Judgement Scale (F)	Gender, Diversity and Inclusion (G)
The Bahamas	2=medium level of evidence	1=low level	0=no economic modelling	1=No use of scenarios	3=Both technocratic and transformative	2= Somewhat unrealistic plan	3= Medium Level
The Republic of Congo	2=medium level of evidence	2=medium level	2=mid-level economic modeling	3 =Extensive use of scenarios	1=Technocratic	2= Somewhat unrealistic plan	2= Low Level
Pakistan	0=no evidence	0=underlying assumptions not specified	0=no economic modelling	1=No use of scenarios	1=Technocratic	1=Very unrealistic/utopian plan	1= Very Low Level
South Africa	2=medium level of evidence	2=medium level	0=no economic modelling	1=No use of scenarios	1=Technocratic	3=Plan with mix of realistic and unrealistic aspects	4= High Level

[Section 3.2.2](#) explains how columns A to D in Table 7 below were weighted and used to determine the judgment scale. The Judgement Scale’s qualitative description in Table 7 corresponds with column F of Table 6, and the results show that Congo’s NDP ranked first based on the judgment scale because of the plan’s use of scenarios and economic modelling.

**Table 7: Judgement Scale Rank**

Criteria	Scores					Judgement Scale Rank	
	Evidence (A)	Assumptions (B)	Economic Modelling (C)	Scenarios (D)	Weighted Scores (E)	Final Rank F = Rank (E)	Qualitative Description
Weight	25%	25%	25%	25%	100%		
The Bahamas	2	1	0	1	1.0	3	2= Somewhat unrealistic plan
The Republic of Congo	2	2	2	3	2.3	1	3= Plan with mix of realistic and unrealistic aspect
Pakistan	0	0	0	1	0.3	4	1=Very unrealistic/utopian plan
South Africa	2	2	0	1	1.3	2	2= Somewhat unrealistic plan

Columns A to C in Table 8 below (plan orientation, judgment scale, gender, diversity and inclusion) were assigned weights to determine the overall rank of all the plans. [Section 3.2.2](#) also explains how they were weighted and used to determine this study’s overall rank.

**Table 8: MRP’s Overall Rank**

Criteria	Scores			MRP's Overall Rank		FTI Rank
	Plan-Orientation (A)	Judgement Scale (B)	Gender, Diversity and Inclusion (C)	Weighted Scores D	Rank E= Rank (D)	FTI Rank F = Rank (FTI Scores in Table 5)
Weight	20%	30%	50%	100%		
The Bahamas	3	2	3	2.7	2	2
The Republic of Congo	1	1	2	1.5	3	4
Pakistan	1	4	1	1.9	4	3
South Africa	1	2	4	2.8	1	1

The overall rank in Table 8 above shows that despite Congo ranking first based on the judgment scale (see Table 7), when other criteria like the plan orientation, gender, diversity and inclusion were weighted, Congo ranked 3rd out of the four countries while South Africa ranked first. Also, Congo would have ranked the least if this MRP had used only the FTI rank (column F in Table 8) as a basis for the overall rank. However, when the plan orientation, judgement scale, gender, diversity and inclusion were considered, especially the latter, Pakistan ranked the least of all four countries. In contrast, South Africa consistently ranked first based on this MRP's 50% weighting on gender and the FTI rank on technology readiness (See Table 5).

Pakistan has a comparative advantage over Congo in size and financial resources. However, as shown in Table 6, the lack of evidence, modelling, assumptions, gender, diversity and inclusion, as well as heavy reliance and control by the state to drive the STI policy, makes the transformative potential of the Pakistan STI policy bleak compared to the STI components of Congo's NDP, the Bahamas NDP and South Africa's White Paper.

## **Chapter 5: Summary, Conclusion and Recommendation**

### **5.1 Summary**

This research established that the characteristics of public goods make a decentralized pricing system incapable of ensuring optimal and equitable allocation of resources wherever there are market failures. The literature shows that technology and innovation are essential for tackling structural issues and achieving the SDGs, especially in developing countries, and STI policies and NDPs need to incorporate a gender lens.

This study used a feminist institutional theory to unpack the formal aspects of STI systems and the gender assumptions and implications that helped assess the gender blindness of these plans. This MRP conducted a content analysis of the STI policy of SA and Pakistan and the STI components of Bahamas and Congo's NDPs. The analysis was grouped across six major themes: data and methodology, forward-looking assessment, financing and performance evaluation, power and gender analysis, scenario and evidence, and finally, the plan orientation and judgment scale. The FTI was then used to substantiate the overall rank of these countries. Across all these metrics, South Africa's White Paper ranked first, and Pakistan ranked the least.

### **5.2 Conclusion**

This MRP had two specific research questions; one is What role does gender play in national planning? Do the STI policies and NDP address gender issues, and if so, how? Based on the occurrence of terms in these plans, gender, diversity and inclusion variables appeared, albeit in varying degrees across the countries, with South Africa and the Bahamas' plans having the most occurrences of these variables. Also, the evidence shows that all the plans interpreted gender as men and women, and there was no consideration for other equity-seeking groups except South

Africa. The STI plans used gender-neutral terms, especially in Congo, Pakistan's and the Bahamas, and lacked gender-disaggregated targets, data, and indicators related to STI and 4IR technologies. This study, therefore, concludes that all these plans are mainly gender blind except for South Africa's White paper, and as Mcphail (2003) argued, there is the need to ask about the gender assumptions and implications of STI policies, which will help "regender" these policies in ways that produce equality.

The second research question is what socio-cultural, institutional, and political barriers impact gender considerations in NDPs and STI policies? Based on the evidence, female participation in STI policy-making is affected by cultural norms, traditions, male chauvinism and stereotypes (OECD, 2018). The public perception of STI as an "elitist and male subject" impacts gender consideration (Ozor et al., 2014). The analysis of the case studies shows the lack of women's representation and that of other equity-seeking groups in the planning process. This lack of involvement of women and other groups is shaped by gender roles and social power relations, especially for women whose responsibilities in the home and social and cultural forces undermine their involvement in the STI planning process. All the plans did not also indicate the role of women civil society organizations except in South Africa, and the role of other equity-seeking groups, residents and citizens in all these plans' formulation processes was unclear.

This MRP also aimed to evaluate more broadly the role of 4IR technologies in STI policies and NDPs, and their relevance for pandemic preparedness. The Bahamas and Congo had no words related to 4IR technologies, which could be because of limitations in human capital and financial resources to have standalone documents that embed 4IR. A subjective analysis of all the plans regarding their funding, scenarios, evidence, gender considerations, and judgement scale shows a lack of readiness for using STI policies for pandemic recovery and future pandemic preparedness.

Other insightful findings include the lack of a clear IP framework and a lack of consideration for bias and ethical issues in the innovation system in all the plans except for South Africa, which addressed the ethical issues and bias around STI through a National Science Innovation (NSI) gender framework. All the plans also lacked a coherent performance M&E system. There was variation in the detail and certainty on funding with heavy reliance on the government, and these plans were mainly technocratic and top-down, which meant citizens and residents were barely involved except for the Bahamas NDP, which was both technocratic and transformative. Also, only Congo clearly stated the actual cost of implementing the plan, which is hard to say if it is sufficient.

### **5.3 Recommendations**

Based on the evidence in chapter 2 from UNCTAD (2021), only a few countries are currently creating frontier technologies but must prepare for them, and developing countries face a huge challenge around lower technological and innovation capacities. This study, therefore, recommends that countries need to adopt STI and 4IR technologies. However, since Congo and Bahamas have limited resources (population size- specialist staff and financial resources) to produce a standalone plan or invest in 4IR, there may be a need for these developing countries without comparative technology advantage to import these frontier technologies. Alternatively, these developing countries could continue to develop local capacities in utilizing their existing technologies till they are ready to integrate with 4IR fully.

Nevertheless, we cannot rely only on STIs because they are rarely a solution independently. Development problems are complex and multidimensional, and all the four case study countries grapple with broader socio, economic and political issues that could undermine the transformative impacts of STI. These include higher energy costs and crime levels, poor infrastructure and

regulatory and approvals inefficiencies, poor governance and corruption. Therefore, STI must be used carefully to prevent unintended consequences and global inequalities (UNCTAD, 2021).

In the interim, developing countries can focus on improving the basic infrastructure (e.g. electricity and ICT) for people and firms and other actors of the national innovation system to have better access to these new technologies (UNCTAD, 2021). While STI needs to embed 4IR technologies across all sectors, policymakers should, from time to time, assess their readiness to use and adapt these emerging technologies for creating a resilient and adaptable innovation system, especially in the fight against Covid-19 and future recessions.

This MRP also draws from the recommendations highlighted in chapter 2 that UNCTAD (2021) provided on aligning STI policies and industrial transformation through incubators, acceleration and innovation labs and ensuring people acquire the necessary digital skills to adopt and adapt frontier technologies. Also, based on Manyena's (2013) calls for post-colonial states to integrate NDPs into a single participatory framework through civil organizations and champions of change, this MRP recommends that developing countries create a synergy between the public sector, private and civil society representing all groups in the STI planning process. There should also be a clear IP framework, substantial STI funding, accountability and a concrete M&E framework for STI implementation.

Like South Africa, countries also need to invest in an NSI gender framework that would provide a holistic approach to STI policy design and implementation and a system for integrating gender equality into ministries and sector programs, including gender analysis of key issues in various sectors. Gender disaggregated data should be collected on STIs, and gender-responsive STI targets should be articulated in the planning process.

Areas for further research will be to examine to what extent these plans are implemented and whether the annual budget includes funding for this plan? Also, is there evidence that suggests that the participation of various gender groups in the STI process leads to advocating for their needs in the STI policy and implementation- For example, if more women are on the STI national planning committee, do they ensure that women, children, and other marginalized groups' interests are meaningfully considered and implemented?

## Bibliography

- Acemoglu, D., & Restrepo, P. (2019). Automation and New Tasks: How Technology Displaces and Reinstates Labor. *Journal of Economic Perspectives*, 33(2), 3–30. <https://doi.org/10.1257/jep.33.2.3>
- Agarwala, R. (1983). *Planning in developing countries: Lessons of experience*. Working Paper 576. Washington, DC, World Bank Staff.
- Aikins, S. (2009). *Global Financial Crisis and Government Intervention: A Case for Effective Regulatory Governance* (SSRN Scholarly Paper ID 2689183). Social Science Research Network. <https://papers.ssrn.com/abstract=2689183>
- Ali, T., Kiani, A., Malik, K., Ramlogan, R., Bashir, T., Kiani, A., Ramlogan, R., & Bashir. (2020). *Impact of Science Technology and Innovation (STI) on Economic Growth and Development: A Case Study of Pakistan under a Creative Commons Attribution-NonCommercial 4.0*. 2, 35–54.
- Amadi, T. K. (n.d.). *Fostering Development Through Planning*. [https://www.academia.edu/34159582/fostering\\_development\\_through\\_planning\\_temple\\_k\\_emka\\_amadi](https://www.academia.edu/34159582/fostering_development_through_planning_temple_k_emka_amadi)
- Aminullah, E. (2020). STI policy and R&D governance for the attainment of SDGs: Envisioning the Indonesia's future. *Asian Journal of Technology Innovation*, 28(2), 204–233. <https://doi.org/10.1080/19761597.2020.1722187>
- Andoh, H. (2019). South Africa's new science policy holds promise, but there are gaps. *The Conversation*. Retrieved January 1, 2022, from <http://theconversation.com/south-africas-new-science-policy-holds-promise-but-there-are-gaps-115078>
- Bacchi, C. (2009). *Analysing policy: What's the problem represented to be?* Frenchs Forest, Australia: Pearson Education.
- Benassi, M., Grinza, E., Rentocchini, F., & Rondi, L. (2020). Going Revolutionary: The Impact of 4IR Technology Development on Firm Performance. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.3625592>
- Bobadoye, A. (2015). *Enhancing Gender in Science, Technology, and Innovation (STI) for Sustainable Development in Africa*. 5.
- Catalyst (2019). *How AI Reinforces Gender Stereotypes (Trend Brief)*. Retrieved April 5, 2022, from <https://www.catalyst.org/research/ai-gender-stereotypes/>
- Chappell, L., & Waylen, G. (2013). Gender and the hidden life of institutions: gender and the hidden life of institutions. *Public Administration*, 91(3) 599-615. <https://doi.org/10.1111/j.1467-9299.2012.02104.x>
- Chimhowu, A. O., Hulme, D., & Munro, L. T. (2019). The 'New' national development planning and global development goals: Processes and partnerships. *World Development*, 120, 76–89. <https://doi.org/10.1016/j.worlddev.2019.03.013>
- Clutton-Brock, P., Massara, P., Kelly, J., & O'Sullivan, A. (2019). *Assessment of market failures and rationale for intervention* (the rationale for an international centre for ai, energy and climate, (pp. 10–12). E3G. <https://www.jstor.org/stable/resrep21843.5>
- Congo National Development Plan: *Growth, Employment, and Poverty Reduction Strategy Paper (2012-2016 DSCERP) | Planipolis*. (n.d.). Retrieved February 15, 2022, from <https://planipolis.iiep.unesco.org/en/2012/congo-national-development-plan-growth-employment-and-poverty-reduction-strategy-paper-2012>

- Cozzens, S. E. (2008). Gender Issues in US Science and Technology Policy: Equality of What? *Science and Engineering Ethics*, 14(3), 345–356. <https://doi.org/10.1007/s11948-008-9061-x>
- Cozzens, S. E. (2021). Inequalities and STI policies: Impact analysis. *Innovation and Development*, 0(0), 1–13. <https://doi.org/10.1080/2157930X.2021.1973650>
- Crespi, G., & Dutrénit, G. (Eds.). (2014). *Science, Technology, and Innovation Policies for Development*. Springer International Publishing. <https://doi.org/10.1007/978-3-319-04108-7>
- Dekens, J., & Dazé, A. (2019). *Conducting Gender Analysis to Inform National Adaptation Plan (NAP) Processes: Reflections from six African countries*. International Institute for Sustainable Development (IISD). <https://www.jstor.org/stable/resrep21970>
- Dewan, S., & Min, C. (1997). The Substitution of Information Technology for Other Factors of Production: A Firm Level Analysis. *Management Science*, 43(12), 1660–1675.
- Erlingsson, C., & Brysiewicz, P. (2017). A hands-on guide to doing content analysis. *African Journal of Emergency Medicine*, 7. <https://doi.org/10.1016/j.afjem.2017.08.001>
- Factors of Production*. (n.d.). Corporate Finance Institute. Retrieved April 2, 2022, from <https://corporatefinanceinstitute.com/resources/knowledge/economics/factors-of-production/>
- Fagerberg, J., & Srholec, M. (2008). National innovation systems, capabilities, and economic development. *Research Policy*, 37(9), 1417–1435. <https://doi.org/10.1016/j.respol.2008.06.003>
- Fagerberg, J., Srholec, M., & Verspagen, B. (2010). The Role of Innovation in Development. *Review of Economics and Institutions*, 1(2). <https://doi.org/10.5202/rei.v1i2.15>
- Feast, J. (2019). 4 Ways to Address Gender Bias in AI. *Harvard Business Review*. <https://hbr.org/2019/11/4-ways-to-address-gender-bias-in-ai>
- Feder, C. (2018). A measure of total factor productivity with biased technological change. *Economics of Innovation and New Technology*, 27(3), 243–253. <https://doi.org/10.1080/10438599.2017.1329697>
- Flowerday, W.T. (2015). Technology/Innovation history of post-apartheid South Africa. University of the Witwatersrand, Johannesburg, South Africa. (1954). *Public Health*, 68, 182. [https://doi.org/10.1016/S0033-3506\(54\)80136-3](https://doi.org/10.1016/S0033-3506(54)80136-3)
- Fourth World Conference on Women, Beijing 1995*. (n.d.). Retrieved April 2, 2022, from <https://www.un.org/womenwatch/daw/beijing/platform/plat1.htm>
- Furtado, C., & Macedo, S. (1990). *Economic development of Latin America: Historical background and contemporary problems* (2. ed., reprinted). Cambridge University Press, Cambridge.
- Galsurkar, J., Singh, M., Wu, L., Vempaty, A., Sushkov, M., Iyer, D., Kapto, S., & Varshney, K. (2018). Assessing National Development Plans for Alignment With Sustainable Development Goals via Semantic Search. *Proceedings of the AAAI Conference on Artificial Intelligence*, 32(1), Article 1. <https://ojs.aaai.org/index.php/AAAI/article/view/11424>
- Ghazinoory, S., & Ghazinouri, R. (2009). Nanotechnology and sociopolitical modernity in developing countries; a case study of Iran. *Technological and Economic Development of Economy*, 15(3), 395–417. <https://doi.org/10.3846/1392-8619.2009.15.395-417>
- Gimenez-Jimenez, D., Calabrò, A., & Urbano, D. (2020). The neglected role of formal and informal institutions in women’s entrepreneurship: A multi-level analysis. *Journal of*

- International Entrepreneurship*, 18(2), 196–226. <https://doi.org/10.1007/s10843-020-00270-8>
- Goal 5: *Gender Equality - SDG Tracker*. (n.d.). Our World in Data. Retrieved April 2, 2022, from <https://sdg-tracker.org/gender-equality>
- González Ramos, A. M., & Bosch, N. V. (2013). International mobility of women in science and technology careers: Shaping plans for personal and professional purposes. *Gender, Place & Culture*, 20(5), 613–629. <https://doi.org/10.1080/0966369X.2012.701198>
- Government of Canada. (2014). *What is gender? What is sex? - CIHR*. <https://cihr-irsc.gc.ca/e/48642.html>
- Green, R. H. (1965). Four African Development Plans: Ghana, Kenya, Nigeria, and Tanzania. *The Journal of Modern African Studies*, 3(2), 249–279. <https://doi.org/10.1017/S0022278X0002365X>
- Gundlach, E. (2005). Solow vs. Solow: Notes on Identification and Interpretation in the Empirics of Growth and Development. *Review of World Economics / Weltwirtschaftliches Archiv*, 141(3), 541–556.
- Gurdeniz, E., St-Onge, E., & Kreher, M. (2021). *How Artificial Intelligence Perpetuates Gender Imbalance*. Retrieved April 5, 2022, from <https://www.oliverwyman.com/our-expertise/insights/2020/mar/gender-bias-in-artificial-intelligence.html>
- Gurumurthy, A., & Chami, N. (2018). Digital India through a Gender Lens. [https://in.boell.org/sites/default/files/digital\\_india\\_through\\_a\\_gender\\_lens.pdf](https://in.boell.org/sites/default/files/digital_india_through_a_gender_lens.pdf)
- Heilmann, S., Shih, L., & Hofem, A. (2013). National Planning and Local Technology Zones: Experimental Governance in China’s Torch Programme. *The China Quarterly*, 216, 896–919. <https://doi.org/10.1017/S0305741013001057>
- Hosein, G., Basdeo-Gobin, T., & Gény, L. R. (2020). *Gender mainstreaming in national sustainable development planning in the Caribbean*. 59. [https://repositorio.cepal.org/bitstream/handle/11362/45086/1/S1901209\\_en.pdf](https://repositorio.cepal.org/bitstream/handle/11362/45086/1/S1901209_en.pdf)
- Hsieh, H.-F., & Shannon, S. E. (2005). Three Approaches to Qualitative Content Analysis. *Qualitative Health Research*, 15(9), 1277–1288. <https://doi.org/10.1177/1049732305276687>
- <http://bahamas.gov.bs>, T. G. of T. B.-. (n.d.). *Vision 2040—National Development Plan of The Bahamas*. Vision2040Bahamas.Org. Retrieved February 15, 2022, from <https://www.vision2040bahamas.org/>
- Kanenberg, H., Leal, R., & Erich, S. “Arch.” (2019). Revising McPhail’s Feminist Policy Analysis Framework: Updates for Use in Contemporary Social Policy Research. *Advances in Social Work*, 19(1), 1–22. <https://doi.org/10.18060/22639>
- Kapungu, R. (2008). The Zimbabwe Gender Budgeting and Women’s Empowerment Programme. *Agenda: Empowering Women for Gender Equity*, 78, 68–78.
- Kim, J. S., & Park, H. Y. (2011). Small Group Support: Attracting and Retaining Women in SET in Korea. *Science and Technology*, 12.
- Klein, P. A. (1988). Changing Perspectives on the Factors of Production. *Journal of Economic Issues*, 22(3), 795–809.
- Iman, M. (2021). Gender Equality in Pakistan: How the Maltreatment of Women Is Undermining the Basic Fundamentals of a Potential Democracy in Pakistan. *Georgia State University*. <https://www.democratic-erosion.com>
- Inglehart, R., Welzel, C., & Norris, P. (2002). Gender Equality and Democracy. *Comparative Sociology*, 1(3–4), 321–345. <https://doi.org/10.1163/156913302100418628>

- Lee, J. E. (2013). *Women in Science, Technology, Engineering, and Mathematics (STEM) Fields: The Importance of the Need to Belong and Self-Esteem on the Intention to Leave a Job* [Master of Arts, San Jose State University]. <https://doi.org/10.31979/etd.5hxr-h4jn>
- Lee, H., & Pollitzer, E. (2016). *Gender in science and innovation as component of inclusive socio-economic growth*. 40.
- Liani, M. L., Nyamongo, I. K., & Tolhurst, R. (2020). Understanding intersecting gender inequities in academic scientific research career progression in sub-Saharan Africa. *Science and Technology*, 27.
- Liao, Y., Loures, E. R., Deschamps, F., Brezinski, G., & Venâncio, A. (2018). The impact of the fourth industrial revolution: A cross-country/region comparison. *Production*, 28(0). <https://doi.org/10.1590/0103-6513.20180061>
- Lin, J. Y. (2012). *New structural economics: A framework for rethinking development*. World Bank.
- Lomazzi, V., & Crespi, I. (2019). Gender equality and gender mainstreaming: The issue of equal opportunities in the European context. In *Gender mainstreaming and gender equality in Europe* (1st ed., pp. 9–30). Bristol University Press. <https://doi.org/10.2307/j.ctvqr1b54.7>
- Mackay, F., Kenny, M., & Chappell, L. (2010). New Institutionalism Through a Gender Lens: Towards a Feminist Institutionalism? *International Political Science Review*, 31(5), 573–588. <https://doi.org/10.1177/0192512110388788>
- Mackay, F., & Krook, M. L. (Eds.). (2011). *Gender, politics, and institutions: Towards a feminist institutionalism*. Palgrave Macmillan.
- Mainlay, J., & Tan, S. F. (2012). *The challenge of gender mainstreaming* (Mainstreaming Gender and Climate Change in Nepal, pp. 5–6). International Institute for Environment and Development. <https://www.jstor.org/stable/resrep01234.7>
- Manyena, S. B. (2013). Non-implementation of development plans and participatory action research in Zimbabwe. *Planning Theory & Practice*, 14(3), 315–332. <https://doi.org/10.1080/14649357.2013.820339>
- March, C., Smyth, I., & Mukhopadhyay, M. (1999). *A Guide to Gender-Analysis Frameworks*. Oxfam Publishing. <https://doi.org/10.3362/9780855987602>
- Marques, P. (2011). ‘Theories and Policies of Innovation: A Critical Review’: Theories and policies of innovation. *Geography Compass*, 5(11), 838–850. <https://doi.org/10.1111/j.1749-8198.2011.00457.x>
- Marshall, C. (1999). Researching the Margins: Feminist Critical Policy Analysis. *Educational Policy*, 13(1), 59–76. <https://doi.org/10.1177/0895904899131006>
- McCombie, J. S. L. (2000). The Solow Residual, Technical Change, and Aggregate Production Functions. *Journal of Post Keynesian Economics*, 23(2), 267–297.
- McKinsey. (n.d.). How Asia can boost growth through technological leapfrogging. Retrieved April 2, 2022, from <https://www.mckinsey.com/featured-insights/asia-pacific/how-asia-can-boost-growth-through-technological-leapfrogging>
- McPhail, B. A. (2003). A Feminist Policy Analysis Framework: Through a Gendered Lens. *The Social Policy Journal*, 2(2–3), 39–61. [https://doi.org/10.1300/J185v02n02\\_04](https://doi.org/10.1300/J185v02n02_04)
- Moser, C., & Moser, A. (2005). Gender mainstreaming since Beijing: A review of success and limitations in international institutions. *Gender & Development*, 13(2), 11–22. <https://doi.org/10.1080/13552070512331332283>

- Munro, L. T. (2020). The resurgence of national development planning: How did we get back here? *International Development Planning Review*, 42(2), 127–138. <https://doi.org/10.3828/idpr.2019.22>
- Ngandu, S. (2008). The absence of gender in South Africa's new industrial policy framework. *Agenda*, 22, 199–207. <https://doi.org/10.1080/10130950.2008.9674998>
- Nishimizu, M., & Page, J. M. (1982). Total Factor Productivity Growth, Technological Progress and Technical Efficiency Change: Dimensions of Productivity Change in Yugoslavia, 1965-78. *The Economic Journal*, 92(368), 920–936. <https://doi.org/10.2307/2232675>
- Lemanowicz, M. (2015). Innovation in economic theory and the development of economic thought. *Acta Scientiarum Polonorum. Oeconomia*, 14(4), 61–70.
- OECD. (2014). *Comparative table of national STI strategies or plans, OECD countries and some major non-OECD economies, 2014*. 110–123. [https://doi.org/10.1787/sti\\_outlook-2014-10-en](https://doi.org/10.1787/sti_outlook-2014-10-en)
- OECD. (2015). *The-future-of-productivity-book.pdf*. (n.d.). Retrieved September 3, 2021, from <https://www.oecd.org/economy/growth/OECD-2015-The-future-of-productivity-book.pdf>
- OECD. (2021). *Science, Technology, and Innovation Outlook 2020: Science and Innovation in Times of Crisis*. OECD. <https://doi.org/10.1787/75f79015-en>
- Öniş, Z. (1991). The Logic of the Developmental State. *Comparative Politics*, 24(1), 109–126. <https://doi.org/10.2307/422204>
- Ozor, N., Oti-Boateng, P., Otwona D. & Ndhine, E. (2014). Mainstreaming gender in the National Science, Technology, and Innovation (STI) policy in Kenya. *Africa Development Policy Study Network. No.44*
- Oyularan-Oyeyinka, B. (2014). The state and innovation policy in Africa. *African Journal of Science, Technology, Innovation and Development*, 6(5), 481–496. <https://doi.org/10.1080/20421338.2014.983731>
- Pakistan-Vision-2025.pdf*. (n.d.). Retrieved January 4, 2022, from <https://www.pc.gov.pk/uploads/vision2025/Pakistan-Vision-2025.pdf>
- Parpart, J. L. (2014). Exploring the transformative potential of gender mainstreaming in international development institutions: Transformative Potential of Gender Mainstreaming. *Journal of International Development*, 26(3), 382–395. <https://doi.org/10.1002/jid.2948>
- Perilla Jimenez, J. R. (2019). Mainstream and evolutionary views of technology, economic growth and catching up. *Journal of Evolutionary Economics*, 29(3), 823–852. <https://doi.org/10.1007/s00191-019-00606-1>
- Philbeck, T., & Davis, N. (2022). The fourth industrial revolution. *Journal of International Affairs*, 72 (1), 17-22.
- Phukon, D. (2008). Gender development approach and social protection: understanding the Case of Assam. *The Indian Journal of Political Science*, 69(4), 771–785.
- Piccone, T. (2017). Democracy, gender equality, and security. Brookings. <https://www.brookings.edu/research/democracy-gender-equality-and-security/>
- Poonacha, V. (2005). Uncovering the Gender Politics of Science Policies and Education. *Economic and Political Weekly*, 40(3), 241–248.
- Ramos, A. M. G., & Bosch, N. V. (2011). Moving for What? International Mobility Strategies of Women in ICT Careers. *International Journal of Gender, Science and Technology*, 3(2), 501–516. <https://doi.org/10.1016/j.evalprogplan.2020.101860>

- Richards, C., Bouman, W. P., Seal, L., Barker, M. J., Nieder, T. O., & T'Sjoen, G. (2016). Non-binary or genderqueer genders. *International Review of Psychiatry*, 28(1), 95–102. <https://doi.org/10.3109/09540261.2015.1106446>
- Rönblom, M., & Keisu, B.-I. (2013). Constructions of innovation and gender (equality) in Swedish universities. *International Journal of Gender and Entrepreneurship*, 5(3), 342–356. <https://doi.org/10.1108/IJGE-09-2012-0047>
- Ross, A. A. (2015). I Am Not Free While [Anyone] Is Unfree: A Proposal and Framework for Enmarginalized Feminist Policy Analysis. *Virginia Commonwealth University's School of Social Work, Richmond, Va.* [https://scholarscompass.vcu.edu/cgi/viewcontent.cgi?article=1000&context=socialwork\\_student](https://scholarscompass.vcu.edu/cgi/viewcontent.cgi?article=1000&context=socialwork_student)
- Rowe, A. M. (2018). Gender and innovation policy in Canada and Sweden. *International Journal of Gender and Entrepreneurship*, 10(4), 344–360. <https://doi.org/10.1108/IJGE-04-2018-0039>
- Sa\_ten\_year\_innovation\_plan.pdf. (n.d.). Retrieved January 1, 2022, from [http://esastap.org.za/wp-content/uploads/2021/05/sa\\_ten\\_year\\_innovation\\_plan.pdf](http://esastap.org.za/wp-content/uploads/2021/05/sa_ten_year_innovation_plan.pdf)
- Samuelson, P. A. (1954). The Pure Theory of Public Expenditure. *The Review of Economics and Statistics*, 36(4), 387–389. <https://doi.org/10.2307/1925895>
- Samuelson, P. A., & Nordhaus, W. D. (2010). *Economics* (19th ed). McGraw-Hill Irwin.
- Schmidt, V. (2005). Definition and Evolution of Gender Mainstreaming. In *Gender Mainstreaming – an Innovation in Europe?* (1st ed., pp. 29–74). Verlag Barbara Budrich. <https://doi.org/10.2307/j.ctvbkjtj7.8>
- Schumpeter, J.A. (1994). *Capitalism, Socialism and Democracy*. VI edn. Routledge, London and New York.
- SDG Index and Dashboards 2018. (n.d.). Retrieved April 2, 2022, from <https://www.sustainabledevelopment.report>
- Sharma, J., & Dhal, S. (n.d.). Perspectives, Policy and Programmes: An Empirical Analysis of ‘Women in Science’ in India. *Science and Technology*, 21.
- Smits, R., Shapira, P., & Kuhlmann, S. (Eds.). (2010). *The theory and practice of innovation policy: An international research handbook*. Edward Elgar.
- Solow, R. M. (1957). Technical Change and the Aggregate Production Function. *The Review of Economics and Statistics*, 39(3), 312–320. <https://doi.org/10.2307/1926047>
- Stiglitz, J. E. (2002). Information and the Change in the Paradigm in Economics. *The American Economic Review*, 92(3), 460–501.
- Taylor, L. (2004). *Reconstructing macroeconomics: Structuralist proposals and critiques of the mainstream*. Harvard University Press.
- Tiedeu, B. A., Para-Mallam, O. J., & Nyambi, D. (2019). Driving gender equity in African scientific institutions. *The Lancet*, 393(10171), 504–506. [https://doi.org/10.1016/S0140-6736\(19\)30284-3](https://doi.org/10.1016/S0140-6736(19)30284-3)
- UNCTAD (Ed.). (2011) *UN Gender Science and Technology.pdf*. [https://unctad.org/system/files/official-document/dtlstict2011d5\\_en.pdf](https://unctad.org/system/files/official-document/dtlstict2011d5_en.pdf)
- UNCTAD (Ed.). (2017) *Innovation, Diversification and Inclusive Development in Africa*. [https://unctad.org/system/files/official-document/ser-rp-2017d2\\_en.pdf](https://unctad.org/system/files/official-document/ser-rp-2017d2_en.pdf)
- UNCTAD (Ed.). (2018). *Harnessing frontier technologies for sustainable development*. United Nations. [https://unctad.org/system/files/official-document/tir2018\\_en.pdf](https://unctad.org/system/files/official-document/tir2018_en.pdf)

- UNCTAD (Ed). (2019). *The Role of Science, Technology and Innovation in Building Resilient Communities, Including through the Contribution of Citizen Science*. United Nations. <https://doi.org/10.18356/3ca6cc2b-en>
- UNCTAD (Ed.). (2020). *The Impact of Rapid Technological Change on Sustainable Development*. UN. <https://doi.org/10.18356/e7663910-en>
- UNCTAD (Ed.). (2020). *A Framework for Science, Technology, and Innovation Policy Reviews: Harnessing Innovation for Sustainable Development*. UN. <https://doi.org/10.18356/cf3559b2-en>
- UNCTAD (Ed.). (2021). *Catching technological waves: Innovation with equity*. <https://unctad.org/page/technology-and-innovation-report-2021>
- UNESCO and UN Division for the Advancement of Women (DAW). (2010). *Gender, Science and Technology: Report of Expert Group Meeting*. [https://www.un.org/womenwatch/daw/egm/gst\\_2010/](https://www.un.org/womenwatch/daw/egm/gst_2010/)
- Valenius, J. (2007). Gender mainstreaming in ESDP missions. *Institute for Securities Study*. 1-77. <https://www.nato.int/ims/2007/win/opinions/Gender%20mainstreaming%20in%20ESDP%20missions.pdf>
- Wajcman, J. (1991). *Feminism Confronts Technology-Pennsylvania State Univ Pr (Txt) (1991).pdf*.
- Wallis, J., & Dollery, B. (1999). Market Failure and Government Intervention. In J. Wallis & B. Dollery (Eds.), *Market Failure, Government Failure, Leadership and Public Policy* (pp. 9–31). Palgrave Macmillan UK. [https://doi.org/10.1057/9780230372962\\_2](https://doi.org/10.1057/9780230372962_2)
- Walsh, P. P., Murphy, E., & Horan, D. (2020). The role of science, technology and innovation in the UN 2030 agenda. *Technological Forecasting and Social Change*, 154, 119957. <https://doi.org/10.1016/j.techfore.2020.119957>
- Waylen, G. (2009). What Can Historical Institutionalism Offer Feminist Institutionalists? *Politics & Gender*, 5, 7–9. <https://doi.org/10.1017/S1743923X09000191>
- Wu, X., & Ramesh, M. (2014). Market imperfections, government imperfections, and policy mixes: Policy innovations in Singapore. *Policy Sciences*, 47(3), 305–320.
- Yirenkyi-Boateng, S. (2010). Development Plans and the Sustainable Development Agenda in Africa: How Critical Realist Conceptualization Can Help. *Journal of Critical Realism*, 9(3), 328–352. <https://doi.org/10.1558/jcr.v9i3.328>
- Yongabo, P., & Göransson, B. (2020). Constructing the national innovation system in Rwanda: Efforts and challenges. *Innovation and Development*, 1–22. <https://doi.org/10.1080/2157930X.2020.1846886>
- Youmans, R. C. (1967). Capital-labor substitution in a developing country. *Proceedings of the Annual Meeting (Western Farm Economics Association)*, 40, 238–242.
- Xu, M., David, J. M., & Kim, S. H. (2018). The Fourth Industrial Revolution: Opportunities and Challenges. *International Journal of Financial Research*, 9(2), 90. <https://doi.org/10.5430/ijfr.v9n2p90>
- Zalewski, M. (2010). “I don’t even know what gender is”: A discussion of the connections between gender, gender mainstreaming and feminist theory. *Review of International Studies*, 36(1), 3–27.

## Appendix

### Appendix 1a: Actual and Normalized Frequency Data (Bahamas and Congo)

Variables	Actual		Normalized Frequency	
	Bahamas	Congo	Bahamas	Congo
<b>Gender</b>				
Gender	175	34	12.68	2.06
Women/girls	278	143	20.14	8.65
Men/boys	101	41	7.32	2.48
Non binary groups/LGBTQ+	1	0	0.07	0.00
<b>Diversity and Inclusion</b>	<b>Bahamas</b>	<b>Congo</b>	<b>Bahamas</b>	<b>Congo</b>
Race/Black people	8	0	0.58	0.00
Ethnicity	5	1	0.36	0.06
Persons/people with disability/ies	118	14	8.55	0.85
Inequality/equality/disparity/ies	144	8	10.43	0.48
Bias/gender Bias	7	2	0.51	0.12
<b>STI</b>	<b>Bahamas</b>	<b>Congo</b>	<b>Bahamas</b>	<b>Congo</b>
STEM	38	1	2.75	0.06
Science and technology/ies/ical	7	7	0.51	0.42
(Scientific) research and development/R&D	2	4	0.14	0.24
Intellectual property rights	4	6	0.29	0.36
Knowledge	84	35	6.09	2.12
Infrastructure	240	328	17.39	19.84
Science	27	17	1.96	1.03
Technology/ies	131	69	9.49	4.17
Innovation/Innovative economy/Innovative people	122	19	8.84	1.15
Data	151	57	10.94	3.45
<b>Fourth Industrial Revolution</b>	<b>Bahamas</b>	<b>Congo</b>	<b>Bahamas</b>	<b>Congo</b>
Artificial Intelligence	0	0	0.00	0.00
Algorithms	0	0	0.00	0.00
Big Data	0	0	0.00	0.00

**Appendix 1b: Actual and Normalized Frequency Data (Pakistan and South Africa)**

Variables	Actual		Normalized Frequency	
	South Africa	Pakistan	South Africa	Pakistan
<b>Gender</b>				
Gender	11	2	11.00	0.73
Women/girls	25	8	25.00	2.91
Men/boys	1	2	1.00	0.73
Non binary groups/LGBTQ+	0	0	0.00	0.00
<b>Diversity and Inclusion</b>				
Race/Black people	30	0	7.61	0.00
Ethnicity	0	0	0.00	0.00
Persons/people with disability/ies	2	0	0.51	0.00
Inequality/equality/disparity/ies	13	3	3.30	1.09
Bias/gender Bias	2	0	0.51	0.00
<b>STI</b>				
STEM	6	8	1.52	2.91
Science and technology/ies/ical	107	98	27.14	35.59
(Scientific) research and development/R&D	86	6	21.82	2.18
Intellectual property rights	8	12	2.03	4.36
Knowledge	122	71	30.95	25.79
Infrastructure	98	25	24.86	9.08
Science	436	267	110.60	96.97
Technology/ies	426	431	108.06	156.54
Innovation/Innovative economy/Innovative people	483	187	122.52	67.92
Data	92	41	23.34	14.89
<b>Fourth Industrial Revolution</b>				
Artificial Intelligence	2	1	0.51	0.36
Algorithms	2	1	0.51	0.36
Big Data	15	5	3.81	1.82

## Appendix 2: Themes and Variables

S/N	Themes	Variables
1	Country	Country, Population, Region, GNI Category, HDI Category
2	Plan Outlook	Document, Title of plan, Years covered, Vision, Theme, Number of pages, Language, Duration, Cost, Drivers of plan, Funder, Preparation approach, Context for preparation
3	Data and Methodology	gender based analysis/methodology, disaggregation by gender, disaggregation by ethnicity, disaggregation by age, disaggregation by socio-economic status, disaggregation by rural-urban/regional factors, Data/methods/evidence used, Performance Monitoring and Evaluation, Typology
4	Evidence	Level of evidence, Analysis assumptions, Economic modelling
5	Scenario snapshots	Past plan achievement, Current plan goals and targets, Plan underpinnings
6	Links to Global Development Goals	Sustainable Development Goals (SDGs) or Millennium Development Goals (MDGs), Reduction in inequality, Reduction in poverty
7	Strategic Focus	Key objectives, legal considerations, economic considerations, environmental considerations, new trends in technologies, political considerations, social factors, Order of precedence of focus, Sectors targeted
8	Financing and means of implementation	Estimated cost of plan, cost of plan as a percent of GDP (average), share of domestic/government financing, share of private financing, share of aid/external financing, Financing mechanisms, Expected roles of the private sector, Expected roles of donors/development partners, Expected roles of donors/development partners, Expected role of civil society sector, Implementation of performance measurement system, Key success factors, Spatial/Regional implementation of plan
9	Key Words	Gender, Race/Black people, Ethnicity, Men/boys, Persons/people with disability/ies, Non binary groups/LGBTQ+, STEM, Science and technology/ies/ical, (Scientific) research and development/R&D, Intellectual property rights, Knowledge, Infrastructure, Inequality/equality/disparity/ies, Artificial Intelligence, Science, Technology/ies, Innovation/Innovative economy/Innovative people, Algorithms, Bias/gender Bias, Big Data and Data
10	Multiple Identities and Gender Neutrality	Use of "gender," Use of gender with other factors, the needs of women, the needs of other equity seeking groups, male experience
11	Language and Equality of Rights	male dominance or female invisibility or the invisibility of other equity seeking groups, gendered expectations and language
12	Power Analysis	evidence of women's involvement, evidence of involving person's with disabilities, evidence of involving other non-binary groups, women organization, integration of gender formal and informal institutions, colonial and political history
13	Issues (Criteria*   Judgement*)	Scenarios, Judgement Scale, Covid-19 Judgement scale
14	Plan Orientation	Technocratic, Transformational