THE GLOBALIZATION OF ARTIFICIAL INTELLIGENCE: AFRICAN IMAGINARIES OF TECHNOSCIENTIFIC FUTURES

YOUSIF HASSAN

A DISSERTATION SUBMITTED TO
THE FACULTY OF GRADUATE STUDIES
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

GRADUATE PROGRAM IN SCIENCE AND TECHNOLOGY STUDIES
YORK UNIVERSITY
TORONTO, ONTARIO

DECEMBER 2022

Abstract

Imaginaries of artificial intelligence (AI) have transcended geographies of the Global North and become increasingly entangled with narratives of economic growth, progress, and modernity in Africa. This raises several issues such as the entanglement of AI with global technoscientific capitalism and its impact on the dissemination of AI in Africa. The lack of African perspectives on the development of AI exacerbates concerns of raciality and inclusion in the scientific research, circulation, and adoption of AI. My argument in this dissertation is that innovation in AI, in both its sociotechnical imaginaries and political economies, excludes marginalized countries, nations and communities in ways that not only bar their participation in the reception of AI, but also as being part and parcel of its creation.

Underpinned by decolonial thinking, and perspectives from science and technology studies and African studies, this dissertation looks at how AI is reconfiguring the debate about development and modernization in Africa and the implications for local sociotechnical practices of AI innovation and governance. I examined AI in international development and industry across Kenya, Ghana, and Nigeria, by tracing Canada's AI4D Africa program and following AI start-ups at AfriLabs. I used multi-sited case studies and discourse analysis to examine the data collected from interviews, participant observations, and documents.

In the empirical chapters, I first examine how local actors understand the notion of decolonizing AI and show that it has become a sociotechnical imaginary. I then investigate the political economy of AI in Africa and argue that despite Western efforts to integrate the African AI ecosystem globally, the AI epistemic communities in the continent continue to be excluded from dominant AI innovation spaces. Finally, I examine the emergence of a Pan-African AI imaginary and argue that AI governance can be understood as a state-building experiment in post-colonial Africa. The main issue at stake is that the lack of African perspectives in AI leads to negative impacts on innovation and limits the fair distribution of the benefits of AI across nations, countries, and communities, while at the same time excludes globally marginalized epistemic communities from the imagination and creation of AI.

Dedication

To my father

To those who fight for freedom every day in Africa

To Bassil, Isis, and Randa

Acknowledgements

This dissertation project was done under unprecedented times and exceptional circumstances. The first is the passing of my father, who has always been the guiding light in my intellectual life and one of the reasons I embarked on this journey. He always wanted me to do this, and I know that he will always be proudly watching me from eternity. The second is the COVID-19 pandemic under which most of the research for this project had to be conceived and carried out. The third is the public murder of George Floyd by police in the US, which sparked a social movement around the Black condition globally. The last event is the return of military rule in Sudan less than two years after the December 2018 uprising that toppled one of the most enduring dictatorships in Africa after three decades of oppressive Islamist regime. While these events afforded my work with even greater meaning than what I had initially envisioned. However, without the support and love of many people around me, I simply would have not been able to put this dissertation together.

I'm deeply grateful for the support and advice of my supervisors, Prof. Stéphane Couture, Prof. Kean Birch, and Prof. Denielle A Elliott. Many ideas in this dissertation came out of generative critiques and rich conversations that I exchanged with them. I'm also extremely grateful to the STS graduate program at York University for providing me with such an intellectual home in which I was able to grow personally and professionally. In particular, my colleagues and friends in the STS community at York were unconditionally kind and generous with their ideas, time, and friendship. I also thank them for the resiliency and dedication they have shown to see this community flourish at York and beyond. Additionally, I'm extremely grateful to the financial support over the past years that I received from the Social Sciences and Humanities Research Council of Canada, the Government of Ontario, and York University.

I feel endless gratitude to the people I have met in my field work for their generosity, intellect, and unequivocal support for my research. I'm especially indebted to Dr. Ann Kingiri at the African Centre for Technology Studies. Without her tireless support and help, I do not think I would have been able to do my field work. The researchers, policy analysts, and start-up founders that I encountered in the field, they all share a common belief in Africa and the African people and

particular ingenuity in the work they are doing in the local context. The people at Canada's IDRC and Global Affairs have been extremely helpful and supportive of this research, not for any reason other than their sincere desire for helping others and believing in the work they are doing. I hope I was able through my research to add a unique purchase to their efforts in pushing for global equalities.

I am extremely thankful to the STS program at Harvard Kennedy School for offering me a fellowship that was instrumental for me to refine my analytical framework and enhance my grasp of co-production. I feel endless gratitude to the other fellows, with whom I became friends and collaborators at the Harvard community for many years to come.

I owe the biggest debt to my family specially my wife Randa, and our children Isis and Bassil. Without their unconditional love, understanding, and support, this work would have not simply seen the light at the end of the tunnel. They make me proud every day. My utmost gratitude goes to my mom and my late father, without their love and support over the years, I would not be here. I am also extremely grateful to my brothers and sister. They always believed in me and extended their love and support in ways that made this journey worthwhile.

Funding Statement

This research was supported by grants from the Social Sciences and Humanities Research Council of Canada (Joseph-Armand Bombardier CGS Doctoral Scholarship and Michael Smith Foreign Study Supplement) and York University (Provost Dissertation Scholarship).

Table of Contents

Abbreviations

The table bale below contains a list of abbreviations and acronyms used in this dissertation.

4IR	Fourth Industrial Revolution
ACTS	African Centre for Technology Studies
AI	Artificial Intelligence
AI4D	AI for development
AU	African Union
GPAI	Global Partnership in AI
ICT	Information and Communication Technology
ICT4D	Information and Communication Technology for Development
IDRC	International Centre for Research and Development
KNUST	Kwame Nkrumah University of Science and Technology
LMIC	Low-Middle Income Countries
NLP	Natural Language Processing
OAU	Organization of African Unity
OECD	Organization for Economic Cooperation and Development
RAIL	Responsible AI Lab
RAIN	Responsible AI Network
SDGs	Sustainable Development Goals
STISA-2024	Science, Technology, and Innovation Strategy for Africa 2024
STS	Science and Technology Studies
WEF	World Economic Forum

List of Tables

List of Figures

1. Introduction

With the globalization of artificial intelligence (AI), Africa is pushed again into fragmented practices of technoscientific innovation. However, technoscientific innovation in the Global South, and particularly Africa, is a messy process. It involves technology transfer, diffusion of innovation practices, political imaginaries of technoscience, international relations, global political economies of innovation, and controversies over technology governance and the relation between technology and society. This project looks at these aspects of AI innovation in Africa through the discourses of local and international social actors. In this dissertation, I examine these discourses of AI innovation through the analytical lens of decoloniality in Africa, historically and contemporary. From this perspective, this project apprehends different visions, ideas, and political imaginaries of the future in Africa as articulated through discourses of AI development by the different AI communities. It shows how these imaginations shape and are shaped by the development of AI technology in the continent.

The link between decolonization and technoscientific innovation has its roots in the struggle for political and economic sovereignty in post-colonial Africa. Since the early days, the protagonists of African independence sought an agenda of political and economic autonomy and technoscientific innovation to restore Africa into its rightful place in world history. Their ideas and visions rested on the return to African communalism, privileged African norms and values, and looked for African ways of knowing and being in the world. These efforts culminated with the emergence of the continental Pan-African project and the establishment of the Organization of African Unity (OAU) to carry out a vision of decolonization in the continent after independence. Decades later, this vision seems to be fading away with the transformation of the OAU into the

African Union[1] (AU). The AU put forward a new agenda to shift the focus of the African organization from the anti-colonial struggle to an "African Renaissance", a vision of inclusive social and economic development in a globalized world, according to the AU. However, it is ironic that the AU quotes Kwame Nkrumah (1909-1972) in its new vision as it marches steadily towards integrating Africa into a modern neocolonial world system (Nkrumah, 1965). It is on this political background that I situate this project in the search for new answers to the ongoing debates about decolonization and modernity in the age of global technoscientific capitalism (Birch & Muniesa, 2020).

The narratives and discourses of the people I presented in this project show contested visions and ideas about what this process looks like in the continent and foreground the inherent tensions in the very idea of modernity (Enwezor, 2010). In other words, what at stake in this project is the opportunity to simultaneously engage with AI innovation with all its flaws and tendencies to universalize sociotechnical practices of technoscientific innovation while seeking alternative futures with AI technology. These futures reflect the desire of different social actors in Africa to have an equal voice in technoscience spaces built with legacies of colonial structures that are still persistent in contemporary global societies with all their asymmetries of wealth and power. This is a worthwhile endeavour because the lack of understanding of the different African perspectives in technoscience including AI threatens to lock knowledge production and governance of AI in Western terrains of development and progress. It also threatens to reduce the debate over AI innovation to binary visions of technological developmentalism or technoeconomic domination.

1 Agenda 2063: The Africa We Want (African Union Commission, 2015).

The failure to see other perspectives limits the distribution of the benefits of AI technology to the globally marginalized epistemic communities in Africa, and elsewhere.

My overarching argument for this dissertation is that technological innovation in technoscience including digital technology and AI, in both its sociotechnical imaginaries and political economies of innovation, excludes purposefully marginalized countries, nations and communities in ways that not only bar their participation in the reception of technoscience, but also as being part and parcel of its innovation creation.

1.1. Research Background

Africa has witnessed growing interest in the application of AI technology in many areas including agriculture, health, education, and so forth. However, this development is problematized by two key issues. First, the role of transnational interest by several nation states and multinational corporations raises concerns about the entanglement of AI technology with global technoscientific capitalism and how this impacts the dissemination and reconfiguration of AI innovation practices, governance, and policy in Africa (McMillan Cottom, 2020; Parayil, 2005; Péloquin, 2017). Second, the lack of African perspectives in the development and diffusion of AI technology exacerbates issues of raciality and inclusion in the scientific research, circulation, commercialization, and adoption of AI in the continent (Kiemde & Kora, 2021; Wairegi et al., 2021). This is further accentuated by dominant understandings of contemporary technoscience as "Western science and technology" or universal and global which creates another category of exclusion where non-Western perspectives of technological innovation and scientific research are sidelined or co-opted (Elshakry, 2010; Harding, 2008). From this vantage point, this project looks at two areas of AI development in Africa.

The first case of AI development in Africa is in the area of AI for development (AI4D). With the recent uptake of AI technology in the Global North, members of the Organization for Economic Co-operation and Development (OECD) are taking steps to ensure that low-and-middle income countries (LMIC) hitch a ride in the AI bandwagon. With the global focus on the UN 2030 Agenda for Sustainable Development and the hype surrounding the vision of the World Economic Forum (WEF) of the Fourth Industrial Revolution (4IR) (aka Industry 4.0), falling behind in AI is not a sensible option for any party. Even with all the promises afforded by AI technology, this development in the North has been plunged by ongoing controversies over biases and discrimination among many other discontents with AI. This development sparked a new global agenda around AI4D in international development circles. This new international gesture towards the always-perceived lagging-behind crowd and in need of assistance and uplifting by the international community is framed around responsible AI to quell the social and economic concerns around AI development. Africa has been one of the recipients of such international boost to help propel its technological capacity to meet the demands of an AI transformed future.

The second case of AI development in Africa is taking hold within the technology start-up ecosystem in the continent. Having not fully recovered from the aftermath of the mobile revolution in Africa, technology entrepreneurs and start-up founders have already embarked on a quest to transform many of the continent struggling economic sectors and turn them around using the powers of AI. However, this sense of optimism is quickly diminished by the realities of the institutional and technological infrastructures in Africa. On the other hand, the difficulties in sourcing the required amount of data for AI application threaten many of these efforts to be shelved aside. For now, this ecosystem seems to be getting a hand from multinational corporations and global philanthropic organizations to keep the engine of AI innovation running in the continent.

This project unpacks the entanglements in these two trends of AI development (AI4D and AI in industry). It takes a critical view that places more emphasis on the social shaping of technological development. Not for the sake of being skeptical of the important role of technological innovation in societal development, but to avoid the tropes of dominant technological determinism of the socioeconomic impact of AI technology in Africa, and beyond.

1.1.1. Theoretical Overview

Dominant narratives about technological development in Africa are locked in binary depictions of the continent that either victimize or fetishize Africa as being exploited or on the rise. These views lack the adequate consideration for the histories and particularities of the African context and the deep understanding of contemporary political and social processes that are taking hold in the continent. In another way, this project has been inspired by the search for alternative narratives to describe a continent that still attempting decolonization while trying to self-fashion its own version of the future. In tackling this challenge, I developed a theoretical framework which I call the Black technoscientific discourses of modernity. I use this framework as an analytical lens from which to examine the implications of AI at the nexus of the imaginations of technoscientific futures and the long-standing social and economic concerns in the continent. The notion of Black technoscientific discourses of modernity is built on decolonial thinking of technoscience and brings together conceptual frameworks from science and technology studies (STS) including the sociotechnical imaginaries (Jasanoff & Kim, 2015) and co-production (Jasanoff, 2004) with contemporary African studies (Mbembe, 2017b; Ndlovu-Gatsheni, 2018; Ngũgĩ wa Thiong'o, 1993).

The sociotechnical imaginaries framework emphasizes the role of political imagination in the understanding of the positive and negative implications of technoscientific innovation. It asserts the performative aspects of visions and discourses of social actors in shaping technoscience practices and influencing the fundamental ethical concerns underpinning technological change. This framework builds on the notion of co-production (Jasanoff, 2004) to understand the mutual constitution of technoscience and society. Co-production asserts the social constructivist paradigm of technoscience and emphasizes the mutual role of discursive and material resources in the production of social order.

On the other hand, contemporary African studies attempts to do two intellectual moves. The first one is to shift the project of theory-making South by looking at contemporary practice in the peripheries (Ngũgĩ wa Thiong'o, 1993). In this sense, it attempts to move the centre by provincializing Euro-America (Ndlovu-Gatsheni, 2018). It argues that the margins are engaged in creative articulations of different modernities and technoscientific formations from below (Enwezor, 2010; Hassan, 2010; Ngũgĩ wa Thiong'o, 2009). On the other hand, it emphasizes that decolonization in Africa meant the complete overthrow of the institutions of modernity post-independence in the continent (Mbembe, 2021; Ngũgĩ wa Thiong'o, 1986).

From this perspective, the notion of *Black technoscientific discourses of modernity* can be understood as an analytical approach that looks at the controversies over technoscientific innovation in Africa as a form of co-production of technoscientific futures and social orders in the project of alternative modernity.

1.1.2. Research Objectives

This project aims to unpack the entanglement of AI development in Africa with global technoscience innovation, technoscientific capitalism, international development practices, and future visions of technoscience and society in Africa. From this angle, this research seeks the perspectives of different social actors (e.g. scientists, researchers, practitioners, policy analysts) in the development of AI in the continent. It also interrogates AI sociotechnical practices in Africa. Additionally, it explores what it means to do AI from the margins and examines the political economy of AI in the continent. Finally, this research investigates AI governance issues in Africa and the possible approaches to technoscience and innovation policy in the continent. In pursuing these objectives, there are three main research questions this project engages with.

1. *How is AI development reconfiguring the debate about development, progress, and modernization in Africa?*

   This question apprehends emerging discourses of AI in Africa in the context of decolonization, past and present. This inquiry reveals political imaginaries of technoscientific futures and particular social orders that are shaping this debate in the continent. It also measures the extent to which the colonial legacy in the continent is influencing the understandings of the risk and benefits of AI development. The aim here is to trace the shift in these discourses as the political realities in Africa move from an era of African independence to globalization and understand how this shift shapes and is shaped by new ideas around economic development and technological innovation.

2. *How is the AI innovation ecosystem configured in Africa and what are the implications for local sociotechnical practices of AI innovation?*

   The idea here is to map the terrain of AI technoscientific innovation in Africa. In doing so, this question develops an understanding of how local sociotechnical practices of AI constitute and are constituted by the economic environment in which AI innovation emerges in the continent. The goal of this investigation is to examine the political economy of AI in Africa. Another objective is to understand what it means do AI from the margins and to what extent this development is shaped by global practices of responsible AI innovation.

3. *What are the AI governance issues in Africa and how should AI governance be approached in the continent?*

   This question has both descriptive and normative aims. The descriptive objective is to identify the debates and controversies surrounding the governance of AI innovation in Africa. This is achieved through the examination of emerging imaginaries of AI in the continent. In light of the understanding of the issue at stake in these imaginaries, the second normative objective is to propose an approach to think about AI governance that can inform technoscience and innovation policy. The main goal is to centre the futures of African people in policy discourse and respond adequately to social justice concerns in the development of AI in the continent.

1.1.3. Methodological Approach

My methodological approach is based on multi-sited ethnographic case studies (Fusch et al., 2017; Hiruy, 2014; Ó Riain, 2009; Schwandt & Gates, 2018). This approach employs multi-sited ethnographic sensibilities (Hine, 2007; Marcus, 1995) by tracing AI innovation networks and

their various pathways, interlocutors, and communities as they travel from Canada to Kenya, Ghana, and Nigeria. Schwandt & Gates (2018) define ethnographic case study as a case study employing ethnographic methods. However, it is not the data collection techniques what sets it apart from other qualitative methods but rather the sociocultural interpretation of the case. Unlike traditional STS ethnographic approaches that are connected to singular sites such as in laboratory studies (Latour, 1983; Law, 2004; Sismondo, 2011), multi-sited ethnographic case studies have become increasingly required to develop more relevant theoretical directions and adequately engage with the multiplicity of technoscience practices and the diversity of groups (publics, practitioners, policymakers) and institutions (scientific, business, governmental, non-governmental) that constitute contemporary technoscience practice that STS wants to influence.

In this project, I followed the AI for Development Africa program (AI4D Africa), funded by the International Development and Research Centre (IDRC), to examine the development visions and conceptions associated with the diffusion of AI in the continent. IDRC is a Canadian federal Crown corporation and Canada's international development agency. It is part of Canada's foreign affairs and development efforts. The AI4D Africa program has three pillars: AI capacity building, AI innovation, and AI Policy. This program is deployed across several African countries. The AI4D case focuses on the programs and efforts supported by the African Center for Technology Studies (ACTS) in Kenya around capacity building, and RAIN (Responsible AI Network) at the AI lab in Kwame Nkrumah University of Science and Technology (KNUST) in Ghana around AI innovation and policy. ACTS is an intergovernmental organization that pursue policy-oriented research focusing on strengthening the capacity of African countries and institutions for applications of science, technology, and innovation for sustainable development in Africa. ACTS is the main administrator of IDRC's AI4D for Africa program. My second case

study focuses on AI in a tech hub in Nigeria that is part of AfriLabs. AfriLabs is one of the large innovation networks in Africa and has more than 100 hubs across several African countries. I followed five AI start-ups working in AgriTech, transportation, insurance, education, and FinTech.

I conducted forty semi-structured in-depth qualitative interviews (Roulston & Choi, 2018) using both purposive and snowball sampling techniques to ensure a range of interlocutors. The purpose of the interviews was to seek deeper insights that cannot be obtained from documents and secondary sources. My interviews included government officials in the Canadian government, IDRC, NGOs, directors, managers, and practitioners in academia and industry who work on research, development, and policy in these African countries. I further employed a combination of discourse and document analysis as a means of triangulating interview data and research findings (Bowen, 2009; Fischer & Forester, 1993; Hajer, 2006; Prior, 2008). The documents include a wide range of topics such as policy briefings and proposals, articles, official government documents, archives obtained from research databases, governments, and NGOs sites.

1.2. Intervention: Decoloniality and African Modernities

There has been a considerable scholarly work theorizing and examining African modernities (Bennett, 2016; Bryce, 2019; Connell, 2007; Hanchard, 1999; Hassan, 2010; Mahmoud, 2015; Mbembe, 2017a; Womack, 2013). However, most of this work has been limited to the investigation of different literary forms (Bryce, 2019) and contemporary African art (Enwezor, 2010; Hassan, 2010). The notion of the Black technoscientific discourses of modernity extends conceptually these theoretical frameworks into technoscience and innovation. On the other hand, the empirical investigation into areas of technoscience and innovation from the perspective of African modernity has been lacking, specifically in the digital realm. In this dissertation, I fill

this gap by examining AI development in Africa. However, this framework can be extended to other areas of technoscience and innovation. By bringing in the discourses of different local actors working on AI development in the continent, I highlight different creative articulations of technological development. These emerging forms of technological development and conceptions of AI demonstrate processes of transformative adaptation of AI in the local context. From the perspective of the Black technoscientific discourses of modernity, these emerging discourses and practices express different sociotechnical imaginaries and forms of co-production from the margins. STS scholars have always examined the relation between Euro-American modernity, and technoscience and innovation (Haraway, 1990; Latour, 1993). However, there has not been enough attention devoted to how this relation plays out in the conception of alternative modernities. The idea is simple yet could be generative and intellectually rewarding. The project of alternative modernity is to look for contemporary practice in habitations not usually considered knowledge-making with the same intellectual curiosity.

1.3. The Structure of the Dissertation

In this chapter, I provided the background for this research project and offered an overview of this dissertation. In the next chapters, I generally recap previous discussions relevant to each chapter and offer a quick introduction outlining the arguments and how I developed them before I continue to detail each one.

Chapter two reviews the relevant literature to this project and identify gaps that this dissertation is attempting to fill. I first discuss the literature on the imaginaries and governance of technoscientific innovation and show how the political imaginations of science and technology influence the governing of technoscientific innovation. In this sense, I show that technoscience

and social order co-produce each other with both material and discursive resources. I then look at the relation between race and technoscience with more focus on anti-colonial computing. I explore the different theoretical approaches that anti-colonial scholars employ in the study of sociotechnical computing practices. I emphasize in this part the geographical situatedness of their conceptual frameworks and analysis. I also discuss the emergence of technoscientific capitalism and trace its genealogy in colonialism and the project of Empire. I show how practices of exploitation, appropriation, and accumulation continue to persist in contemporary digital formations. I end this chapter with a review of the literature on AI in Africa. I show that the debates surrounding the social, economic, and political implications of AI in the continent frame AI development between two binary visions of socioeconomic remedy or technoeconomic exploitation.

Chapter three focuses on the development of the theoretical framework of this project in light of the literature review. I bring philosophical and theoretical perspectives from contemporary African studies into the governance of technoscience and the political economy of technoscience. The result of this crosspollination between science and technology studies and African studies is a theoretical framework that takes the perspectives of the Black technoscientific discourses of modernity to analyze the development of AI in Africa.

Chapter four outlines the methodological approach undertaken in the collection and analysis of the data of this project. I discuss the approach to conducting the two empirical cases, interviews, participant observation, and document analysis. I also discuss the coding and analysis process of the data. I end the chapter with a methodological reflection on the issues encountered in the field including the limitations, politics of the research, and my positionality.

The next three chapters present my empirical analysis. Chapter five focuses on decolonization in Africa and asks the question of what it means to decolonize AI. In pursing this question, I first look at two neglected histories of Pan-Africanism and African socialism to ground decolonial perspectives on ideas of political and economic sovereignty in post-independence Africa. I then turn to emerging narratives of decoloniality in the discourses of my interlocutors as they discuss their conceptions of decolonizing AI. By tracing emerging discourses and practices of decolonization, I show that decolonizing AI has become an imaginary about particular technoscientific futures in Africa. I look at these discourses to examine how AI is reconfiguring the debates about development, progress, and modernization in Africa.

Chapter six maps the terrain of AI innovation in Africa and its implications for local sociotechnical practices of AI innovation in the continent. In the case of AI innovation, I introduce new protagonists including the state and the international assistance actors alongside my interlocutors. I look at how practices of international development, corporate social responsibility, and philanthropy configure the AI innovation ecosystem. I examine the implications of responsible AI as farmed by the international community, and the lack of African context in AI as framed by local actors in the continent. I show that to the contrary, the framing of responsible AI based on a deficit logic sustains the exclusion the AI African communities from the creation and imagination of the AI technology.

Chapter seven focuses on AI governance in Africa. I examine two contrasting Pan-African imaginaries of AI. The first one is put forward by the AU and the second one by local actors. I discuss the implications of both imaginaries for AI governance in Africa. I show that the AU mobilizes normative visions of technoscience, and innovation and foregrounds economic rationales to attract international development and strengthen the collaboration between the market

and the state. On the other hand, local actors attempt to reclaim sovereignty over the development agenda and the technoscientific innovation process in the continent. I show that what at stake in this debate is the sovereignty of the African state. As such, I suggest that one way of approaching the governance of AI is to look at AI development as a state-building experiment in post-colonial Africa.

Chapter eight concludes this dissertation by offering a recap of the work done and summaries the findings and contribution of this project. I synthesize my main argument which is that emerging articulations of technoscientific innovation in AI in Africa can be understood as sociotechnical imaginaries of alternative modernity that influence the co-production of technoscience and society in Africa. I also discuss the limitation and future research direction based on the findings of this research. I end the chapter and the dissertation with a more general discussion on decoloniality, the global politics of knowledge, and the policy implications in light of this research.

2. Literature Review: Anti-Colonial Computing, Sociotechnical Imaginaries, and the Political Economy of AI

2.1. Introduction

In this chapter, I review relevant literature from STS and AI for development (AI4D) to provide an overview of how the social, political, and economic implications of AI have been understood within these two areas in which this dissertation project is situated. I also discuss relevant literature on AI development in Africa and outline some of the gaps in this literature. I start by reviewing the sociotechnical imaginaries framework (Jasanoff & Kim, 2015) and discuss the notion of co-production (Jasanoff, 2004) of technoscientific knowledge and social order.

In building on the concept of sociotechnical imaginaries, I examine two under-theorized elements of this theoretical approach. First, the economic context in which technoscience and innovation are produced (Birch, 2013; Mavhunga, 2017; Pinch & Swedberg, 2008; Tyfield, 2012; Tyfield et al., 2017). Second, with few exceptions (Bowman, 2015; Storey, 2015), the focus on the politics of science and technology has been on the Global North (Jasanoff & Kim, 2015; Sismondo, 2020) and lacks the adequate consideration for the racialized social structures of the epistemic communities in which science, technology, and innovation are produced. As a result, this theoretical approach lacks the understanding of the co-production practices associated with the exclusion of marginalized and underrepresented social groups from dominant sociotechnical imaginaries.

In the next chapter, the theoretical framework, I extend conceptually the imaginaries framework through crosspollination between STS literature and contemporary African studies literature and integrate concepts from the political economy of technoscience and anti-colonial STS. However, in this chapter, I first focus on introducing the raciality of technoscience and

reviewing the different theoretical frameworks used by anti-colonial scholars in STS and conjugate fields to examine the relation between race and technoscience (Ali, 2014; Anderson, 2002; Harding, 2008, 2011; Irani et al., 2010; Philip et al., 2012; Smith, 2012). I then introduce relevant literature on the political economy of technoscience (Birch, 2017; Birch & Tyfield, 2013; Pinch & Swedberg, 2008; Tyfield et al., 2017) and examine the evolving relation between capitalism, race, and emergent forms of technoscientific empires.

The underlying argument in this chapter is two folds. First, while there is growing literature investigating the social, economic, and political implications of AI. However, this literature overwhelmingly focuses on the Euro-American context and lacks the understanding of the implications of AI technology in the Global South, and particularly Africa. Second, there's a dearth of literature on AI in Africa. As little as it is, this literature (Bjola, 2021; Gwagwa et al., 2021; Hilbert, 2016; Mann & Hilbert, 2020; Wall et al., 2021) tends to take a universal view of AI based on Western epistemology and normative claims about the benefits and risks of AI and lacks the consideration for how AI technology is understood by different social actors in Africa. As a result, the socioeconomic implications of AI remain understudied in the continent.

2.2. The Sociotechnical Imaginaries

In this section, I discuss the sociotechnical imaginaries framework and highlight some of the gaps in this analytical approach, specifically in the areas of the political economy of technoscience and the relation between race and technoscience. I provide an overview of how this concept has been deployed to analyze the relation between technological development and political culture in producing, contesting, and destabilizing/stabilizing future visions of social life that are constituted by technoscience and innovation. The concept of sociotechnical imaginaries is a

prominent concept in STS that has been widely used in other fields as well (Huang & Westman, 2021; Mladenović et al., 2020; Tidwell & Tidwell, 2018; Tironi & Albornoz, 2021). STS can be defined as the social study of science and technology (Bijker et al., 2012; Bijker & Law, 1994; Pinch, 2007). The work of STS scholars examines the materialities of science, technology, and innovation, and has always existed across disciplines investigating the social, political, economic, and cultural implications of technoscience (Hughes, 1987; MacKenzie & Wajcman, 1999; Pinch & Swedberg, 2008; Sismondo, 2007; Winner, 1980).). For example, STS examines issues at the nexus of innovation studies, information and communication studies, policy studies, political economy, and governance of technoscience and innovation (H. M. Collins & Evans, 2002; Fuller, 1999; Gieryn, 1983; Godin, 2017; Jasanoff, 2011; Mazzucato, 2013; Mirowski, 2011; Sarewitz & Pielke, 2007).

The sociotechnical imaginaries framework is developed by Jasanoff & Kim (2009) and looks at the political dimension of technoscientific knowledge production. It investigates how future visions of societal development inform policy choices and their implications for technoscience governance (Jasanoff & Kim, 2009). From a broader theoretical perspective, the sociotechnical imaginaries framework analyzes how political cultures shape the understandings of the risks and benefits of technology and to what degree these visions, ideas, and assumptions influence the fundamental ethical questions underpinning technological development. Jasanoff (2015) describes sociotechnical imaginaries as "collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology" (p. 6). From this perspective, the sociotechnical imaginaries framework analyzes the co-production of knowledge and the political materiality of technoscience (Jasanoff 2004; Jasanoff

& Kim, 2009). Co-production is the idea that "social order" is produced by both material and discursive resources (Jasanoff, 2004).

Co-productionist approaches have their deep roots in STS (Haraway, 1988; Latour, 1983, 1993; MacKenzie & Wajcman, 1999; Pinch & Bijker, 1984). These STS scholars argue that the tensions between technological and social determinisms have always been present in societal debates about the impact of scientific and technological change in society. Jasanoff (2004) developed co-production as an attempt to look beyond the dichotomies of both natural and social determinism. She argues that social and technoscientific orders co-produce each other. She contends that the knowledge and representations of the world in terms of both nature and society are inextricably linked to the political choices and the ways in which people choose to live in it. In this sense, Jasanoff (2004) argues for a different way of looking at the production of the future that considers both the imaginative and the material while foregrounding the political in dealing with issues of constitutive power, governance, and the mutual stabilization and destabilization of both technoscience and society. Building on co-production, Jasanoff & Kim (2009) developed the concept of sociotechnical imaginaries to 'show how different imaginations of social life and order are co-produced alongside the goals, priorities, benefits and risks of science and technology' (p. 141).

Originally, Jasanoff & Kim (2009) specified that sociotechnical imaginaries is one of the ways that co-production manifests itself in the national context through the emergence of visions that describe 'collectively imagined forms of social life and social order reflected in the design and fulfillment of nation-specific scientific and/or technological projects' (Jasanoff & Kim, 2009, p. 120). However, Jasanoff (2015) argues that visions of the future articulated in sociotechnical imaginaries can come from both state and non-state actors. Jasanoff (2015) maintains that

imaginaries manifest themselves in discourses, identities, institutions, and representations including material artifacts. Jasanoff & Kim (2013) argue that sociotechnical imaginaries are inspired by collective understanding of what is good or desirable in a particular society and how technoscience can fulfil these projects. They also contend that sociotechnical imaginaries influence processes of reconfiguration of physical and social infrastructures and the establishments of new patterns of life that are required for such technological futures (Jasanoff & Kim, 2013). From this perspective, the sociotechnical imaginaries framework highlights societal norms and normative claims embedded in particular political cultures about science and technology and examines the underlying future visions of world-making projects and social change enabled by technoscientific development.

The sociotechnical imaginaries framework has been mobilized in many areas to understand the debates and controversies surrounding technological developments and innovations such as smart cities (Miller, 2020; Richter et al., 2017; Sadowski & Bendor, 2019), energy transitions (Ballo, 2015; Levenda et al., 2019; Sovacool et al., 2020), fourth industrial revolution (Avis, 2018; Schiølin, 2020; Vicente & Dias-Trindade, 2021), digital platforms (Felt, 2015b; Hassan, 2020; Mager & Katzenbach, 2021), and other emerging technologies such as AI, big data and Blockchain (Bareis & Katzenbach, 2021; Felt & Öchsner, 2019; Groos, 2020; Guay & Birch, 2022; Kazansky & Milan, 2021; Reijers & Coeckelbergh, 2016).

The sociotechnical imaginaries framework has been deployed in this literature to understand how civic epistemologies and public understandings of technological development influence and implicate state and non-state responses to the articulated risks and benefits of these technologies by different actors including experts and the publics. Jasanoff (2007) defines the notion of civic epistemologies as culturally informed ways that the publics expect the expertise,

knowledge, and reasoning of the state to be produced, tested, and used in decision making. Furthermore, the analytical canons of the sociotechnical imaginaries are used to examine technoscience and innovations policies (Felt, 2015a; Kim, 2017; Pandey, 2014; Smallman, 2020; Sovacool, 2019). For example, the sociotechnical imaginaries framework is used to analyze the gap between policy frameworks and effectiveness of innovation instruments and outcomes linking the successes and failures of innovations to how effectively sociotechnical imaginaries of a particular innovation are articulated in the national context (Pfotenhauer & Jasanoff, 2017). It is important to mention that Jasanoff & Kim (2009, 2013) argue that imaginaries do not determine policy outcomes, but offer a powerful cultural reservoir that can help shape the policy responses to technological innovations. For instance, the sociotechnical imaginaries framework is used in policy studies to understand how future visions associated with technological change inform the development of social and political systems including government policy and regulations (Kim, 2017; Smallman, 2020). In this sense, the sociotechnical imaginaries framework investigates how stakeholders and the publics participate in the co-production (Jasanoff, 2004) of technological and societal developments.

The sociotechnical imaginaries framework has many advantages in the sense that it brings cultural meanings into sociotechnical change and highlights dominant narratives in societies and particular communities about how they view their pasts and futures, according to Sovacool & Hess (2017). They argue that while the concept clearly rejects both political and technical determinisms and fiercely interrogates the legitimacy of political ideas and their rationality and stresses the performativity aspects of sociotechnical imaginaries. For example, Sovacool & Hess (2017) bring attention to the analytical strength of the sociotechnical imaginaries in uncovering the process of extension by which certain ideas and narratives acquire more momentum that help them become

more sticky, durable, and scalable as sociotechnical projects move from imagination to realization. Furthermore, Tyfield (2012) highlights the strength of this approach in capturing the messy, contradictory, and unintended outcomes of technoscientific policy by bringing more qualitative orientation into technoscience policy issues and looking beyond science as an objective truth or sound science raising important questions about publics and expertise.

On the other hand, this theoretical approach has a few shortcomings and weaknesses as noted by Sovacool & Hess (2017) and Tyfield (2012). For example, Sovacool & Hess (2017) highlight the issue of research boundaries when applying the concept in studying imaginaries. They point out to a set of challenges in drawing temporal lines between past, future or even distant future and where an imaginary begins to differ spatially between different stakeholder groups and locales. Additionally, they point out to the fragmented nature of imaginaries due to their inherent subjectivity which also makes it challenging to clearly navigate between collective formations and individual identity in the conception of imaginaries. Sovacool & Hess (2017) argue that the imaginaries may overlook the complete interaction in the intertwined relations between actors, social structures, and institutions and remain limited to descriptive cultural analysis.

On the other hand, Tyfield (2012) points to two significant weaknesses of this approach which are "the neglect of systematic analysis of political economy and the concept of power" (p. 160). He argues that the sociotechnical imaginaries framework lacks the adequate theorization of the concept of democracy which negatively affects the imaginaries framework's ability to offer the tools capable of producing radical transformations of the technoscience politics it advocates. Tyfield (2012) argues that the concept of democracy is afforded unchallenged positive meaning in this approach that overlooks the challenges of exercising effective public engagement and coaptation of ideas such as public trust in science by powerful actors in the policymaking process.

He also argues that while the co-production approach attempts to open up science policy, its lack of engagement with political and economic crises in technoscientific knowledge production makes this approach susceptible to harmless incorporation by capitalist regimes of technoscience knowledge production to justify their policy.

Additionally, I argue that the lack of adequate engagement with the concepts of power and democracy (Tyfield, 2012), particularly in non-Western contexts, results in overlooking the challenges of marginalized and underrepresented social groups in the creation of, and contribution to dominant sociotechnical imaginaries within racialized social structures of the epistemic communities engaged in technoscience and innovation. This is further complicated by the imaginaries lack of adequate engagement with questions of the political economy and consideration for the economic environment that influences technoscience knowledge production and innovation (Birch, 2013; Tyfield et al., 2017). In the next sections, I address these shortcomings in more details.

2.3. Raciality of Technoscience

STS scholars have interrogated technoscientific knowledge production in the context of racial analysis from several perspectives including postcolonial, decolonial, and intersectional analysis. In this section, I first outline main strands of this literature showing the differences between intersectionality, postcoloniality, and decoloniality in terms of geographies, timeframes, and epistemology. This overview is essential because it shows that discussions of decolonization need to be geographically situated. For example, and as I show in the empirical chapters, decolonization in Africa has different historical trajectories and understandings that are specific to the post-independence struggle in the continent. The discussion in this chapter demonstrates how

these analytical approaches differ in the ways in which they inform racial analysis of technoscientific knowledge production and illustrates the need for a specific perspective when looking at computing, digital technology, and AI in the African context. In this section, I review how the relation between race and computing including AI has been discussed while highlighting some of the gaps in this literature. I argue that most of the recent literature on AI is focused on the Euro-American context and lacks the understanding of AI in the Global South, and particularly in Africa.

The different analytical approaches presented in this section share common ground with critical race theory which criticizes white hegemonic discourse and power, analyzes the social disparities between races, challenges popular notions of the construction and employment of race, racism, and racial power in society, and works toward the elimination of racial oppression with the goal of ending all forms of oppression (Bhambra, 2014; Cooper, 2016; Delgado et al., 2017; Donnor, 2005). STS literature in this area includes the work of critical Black, Indigenous and feminist STS scholars whose work has been instrumental and central to discussions of radicalization in technoscience (Anderson, 2002; Haraway, 1990; Harding, 2008; Liboiron, 2021; Pollock & Subramaniam, 2016; Subramaniam et al., 2016; TallBear, 2013). These STS approaches challenge the historical narratives and context of modernity, links modernity to race formation and unequal distributions of power, while rejecting notions of objectivity, universality, and neutrality, and framing race as a social, political, and economic classification system. In what follows, I discuss three main perspectives of racial analysis, namely intersectionality, postcoloniality, and decoloniality, showing some of the differences in their approaches and outlining some of the gaps in anti-colonial technoscience literature when looking at AI development in Africa.

2.3.1. Intersectional STS and AI

Intersectional STS scholarship (Benjamin, 2019a; Kaijser & Kronsell, 2014; Nakamura & Chow-White, 2011; Noble, 2018; Roberts, 2013) is informed by the work of Black feminist scholars in the US such as Kimberlé Crenshaw and Patricia Hill Collins. Black legal scholar Kimberlé Crenshaw coined the term intersectionality and argued that Black females are discriminated against in ways that don't fit the US legal system definition of categories of sexism and racism (Crenshaw, 1989, 1991). Intersectionality is centred around the argument that Black women are subordinated within intersecting oppressions of race, class, gender, sexuality and nation (P. H. Collins, 2008, p. 22).

A body of intersectional scholarship focused on the relation between race and technoscientific knowledge production in modern technology including AI and digital platforms has emerged in recent years (Benjamin, 2019a, 2019b; Gray & Sarkeesian, 2020; Nakamura & Chow-White, 2011; Noble, 2016, 2018). Intersectional STS scholars argue that the concurrent existence of racism and sexism is part of the social structures and economies that are foundational for experiences and cultures in digital technologies, platforms and infrastructures, according to Noble (2016). Many of these studies link the issue of bias in AI to the focus of AI research on White-male issues which results in problems of exclusion, inequality, and discrimination. Other non-intersectional scholars have also examined the exclusion of perspectives of racialized and underrepresented groups in the development of digital technologies and the normalization of White-male values and perspectives in AI technology discourse and design (Boyd et al., 2014; Crawford, 2016; O'Neil, 2017; Zarsky, 2016).

However, what distinguishes intersectional literature such as (Benjamin, 2019b; Noble, 2018; Ogbonnaya-Ogburu et al., 2020) is the focus beyond issues of representations and the

interrogation of practices such as colour-blind racism in digital technology and AI systems while contextualizing these practices in histories of racial discrimination and inequalities in the US. For example, Benjamin (2019b) conceptualizes these forms of colour-blind racism as the New Jim Code: 'the employment of new technologies that reflect and reproduce inequalities but are promoted and perceived as more objective or progressive than the discriminatory systems of a previous era' (pp. 5–6). Similarly, Noble (2018) conceptualizes forms of colour-blind racism in the context of automated decision systems, as technological redlining: 'the design of digital technologies that enact new modes of racial profiling that are underpinned by capitalists logics, values and assumptions in a way that reinforces oppressive social relationships' (p. 1). Furthermore, intersectional approaches frame AI sociotechnical practices as part of racial digital technologies assemblages that operate at the intersection of race, gender, class, power, sexuality, and other socially constructed categories to create matrix of relations that makes the conditions of inequality and oppression possible in digital technology phenomena, according to Noble (2016). For example, Benjamin (2019b) argues that racism in AI is codified and embedded in predictive models, and enabled by haphazard data collection, spurious correlations, reinforced by institutional inequalities, and distorted by confirmation bias.

However, these intersectional approaches are rooted in the Euro-American context and remain connected to their interlocutors in the West. More specifically, intersectionality has emerged as a Black feminist theory in the US and was concerned with forms of activism and civil rights that emerged in the US in the eighties. For example, Jim code comes from a long history of racial discrimination against Black people in the US and particularly in the US south with the Jim Crow racial segregation laws. The concept of technological redlining comes from a long history of housing discrimination against Black people in the US. Furthermore, Patricia Hill Collins, one

of the prominent scholars of Intersectionality and Black Feminist Thought developed the concept of Black Feminist Epistemology which is centred around the idea that the specific 'lived experiences' of African-American women reflects distinctive ways of knowing and understanding the world and that the politics of race and gender also influence knowledge production (P. H. Collins, 2008, p. 251). From this perspective, intersectionality seeks an alternative to dominant knowledge production systems in the US.

2.3.2. Postcolonial and Decolonial Computing

In this section, I discuss both postcolonial and decolonial approaches, showing their differences in terms of epistemological origins and their respective critiques of technoscientific knowledge production. Postcolonial and decolonial approaches have been mobilized by scholars in many areas including information and communication studies (Ali, 2014; Dourish & Mainwaring, 2012; Irani et al., 2010; Philip et al., 2012) and science and technology studies (Anderson, 2002; Bonneuil, 2000; Harding, 2011) to examine issues in the broader area of Information and Communications Technologies for Development (ICT4D) including computing, human computer interaction (HCI), software and hardware design, among other subareas. Both postcolonial and decolonial computing literature (Ali, 2014; Philip et al., 2012) contend several critical questions and concerns influenced by the conditions of coloniality that are relevant to ICT4D projects in the Global South. However, there are some differences in terms of epistemology between postcolonial and decolonial approaches that I outline below.

The work of postcolonial STS scholars (Anderson, 2002; Harding, 2011) is informed by diasporic scholars such as Edward Said and Gayatri Chakravorty Spivak from the Middle East and South Asia and refers back to their locations and imperial interlocutors (i.e. Europe and the West).

This body of literature is centred around the critique of modernity and the idea of the "universal" and challenges the claims of superiority of Western science and Western civilization (Said, 1979; Spivak, 2010). For example, Said (1979) was concerned with challenging the idea of the "universal" and the dichotomy of "us" and "them". He argued that the idea of the "universal" was based both on an analytical division of the world and the omission of the other which removed the "Other*"* from the production of an effective history of modernity. This has made history the product of the West in its actions upon others, according to Said (1979). He argued that History, as a product of the West, displaced those actions in the idea that modernity was internal to or originated in the West, thereby erasing the "Other" from history. In his view, this naturalized and justified the West's material domination of the "Other".

On the other hand, decolonial and Indigenous STS scholarship (Boisselle, 2016; Cruikshank, 2006; Foster, 2017; Kukutai & Taylor, 2016; TallBear, 2013) is informed by the work of diasporic scholars from South America such as Aníbal Quijano and Walter Mignolo, and for the most part, refers back to Euro-America. Bhambra (2014) argues that decoloniality differs in the sense that it addresses a much longer timeframe that starts with the earlier European incursions upon the lands that are known as the Americas since the fifteenth century. Quijano (2000) introduced the concept of the coloniality of power and argued that practices and legacies of European colonialism are still experienced in contemporary settler and colonized societies and that those forms of social discrimination have outlived formal colonialism. Quijano (2000) conceptualized the coloniality of power as racial, political, and social systems or social orders that are imposed by colonial powers in Latin America, Africa, and much of the colonial world assigning value to certain people or societies while marginalizing others. As a concept, coloniality of power is organized around three systems including systems of hierarchies which are based on race as a

social and political classification system created by Europeans on which labour and economic systems are built. Systems of knowledge based on European knowledge and ways of knowing and production of knowledge that are Western. Lastly, cultural systems which include Eurocentric norms such as economic systems (e.g. capitalism, socialism, and so forth), modern culture, science and technology.

From this perspective, decoloniality attempts to go beyond the cultural realm and firmly ground itself in the material to examine the colonial and racial experience from multiple dimensions including the production and embodiment of Indigenous and local knowledge as well as economic exploitation. Bhambra (2014) argues that while postcolonial scholarship examined issues related to the material and socioeconomic nevertheless, it maintained a strong tendency to remain fixated in the realm of the cultural. In contrast, decolonial scholarship remained strongly linked to world-systems theory and traditions of critical social theory of the Frankfurt School, according to Bhambra (2014). This is reflected in the different racial analysis and critical approaches to sociotechnical practices of computing including those of AI, as I discuss next.

For example, postcolonial computing tends to be more cultural, focusing on situated knowledge production practices of computing and trying to bring postcolonial sensibilities into the design and development of Information and Communication Technology (ICT), according to Ali (2014). Particularly, postcolonial approaches attempt to address issues in technology development as it relates to global connectivity and movement by engaging with generative models of culture, looking at development as a historical program, examining uneven economic relations, and considering cultural epistemologies in the design and development of technology, as explained by Irani et al. (2010) and Philip et al. (2012). In this sense, postcolonial computing looks at postcoloniality as a project about "the historical transformation of conditions of cultural

encounter" and understands technology research, design, and practice as "culturally located and power laden" (Irani et al., 2010, pp. 1311–1312). However, postcolonial computing approaches have been criticized as being grounded in Western epistemologies including the critique of modernity from Eurocentric perspective and only concerned with how postcolonial theory can inform areas such as ICT4D, and technology design and development (Ali, 2014; Bhambra, 2014).

On the other hand, decolonial computing looks at computing as inherently colonial practice that is influenced by existing economic asymmetries, uneven global structural and institutional power, and colonial relations and epistemologies that continue to persist and inform contemporary computing practices (Ali, 2016; Dourish & Mainwaring, 2012). Decolonial computing scholars are more concerned with critiquing the historical origins of computing and the epistemologies that inform their knowledge production practices, according to Ali (2014). In this sense, decolonial computing tends to foreground the geopolitical and the political orientation and the positionality of those practising and researching computing. For example, Ali (2016) argues that decolonial computing is a way to think through what it means to design and develop computing technology for and with those in the margins of the world systems using epistemologies and ways of knowing situated in the peripheries and attempting to decentre Euro-American centric universals.

While decolonial computing seems to have more strength in tackling issues of raciality and exclusion of the globally marginalized epistemic communities from computing knowledge production. However the way that decoloniality has been mobilized in AI today seems to only broaden the critique around the major discontents with AI such as algorithmic biases and the reinforcement of inequality and discriminatory patterns, as argued by Adams (2021). Additionally, some decolonial literature in AI such as (Irwin & White, 2019; Mohamed et al., 2020; Rapanyane & Sethole, 2020) attempts to bring non-Western epistemologies to address the ethical issues in

contemporary formations of digital technology and AI; however, it doesn't question the epistemological origins of notions of intelligence and ethics in AI (Adam, 2002; Adams, 2021). Today, decoloniality has been widely mobilized in AI ethics, however, most of the literature on decolonizing AI doesn't seem to problematize the normative notions of intelligence and ethics. Adams (2021) argues that AI ethics is based on colonial logics of rationality and Euro-American centric conceptions of ethics and intelligence and asks the question of whether AI can be decolonized. There's a dearth of literature that looks at the historical origins of these concepts at the epistemological level and attempts to read AI with histories of colonialism. This is a necessary move to critique universalist understandings of AI and examine the underlying ethical questions underpinning AI development, specifically in the Global South.

In summary, while the three discussed approaches of technoscience raciality overlap in terms of their social projects. However, they differ in their epistemology which influences the ways in which the ethical issues in AI can be approached across different geographies. For example, intersectionality appears to be focused more on the Euro-American context while postcoloniality and decoloniality tend to focus more on the Global South. While scholars have extended decoloniality to different areas of computing practices (Ali, 2014, 2016; Mohamed et al., 2020; Peña1 & Varon, 2019), decolonial computing remains undertheorized (Ali, 2016) and lacks the adequate considerations for the geopolitical specificities of the African context. Nevertheless, the raciality aspects of technoscience can enhance the understanding of the sociotechnical imaginaries in the Global South, and particularly Africa. In the next chapter, I show how these understandings can be incorporated in a theoretical framework that is more suitable for analyzing imaginaries of technoscientific futures in Africa. However, in the next section, I move to a discussion of another undertheorized aspect of the sociotechnical imaginaries framework.

2.4. The Political Economy of Technoscience: AI, Data, Race, and Empire

The political economy of technoscience is concerned with the production, dissemination and consumption of technoscientific knowledge and how this configures and is configured by political economies of technoscience and innovation (Birch, 2013; Godin & Vinck, 2017; Mirowski, 2011; Tyfield et al., 2017). In this section, I start by discussing the literature on the political economy of technoscience around AI, data, and innovation highlighting some of the gaps in this literature, specifically the lack of focus on digital economies of the margins including Africa (Graham, 2019). I then discuss the literature on the relation between technoscientific capitalism, race, and empire. This is an important discussion because these categories are inextricably linked to enduring legacies of colonialism and neocolonialism that continue to persist in contemporary political economies of technoscience and innovation.

I argue that despite the growing technoscientific innovation practices in the Global South, most of the existing literature on the relation between the economy and technoscientific knowledge production remains focused on investigating practices of technoscientific capitalism (e.g. digital labour and data exploitation) and the political imaginaries in the Global North (Arvidsson & Colleoni, 2012; Bilić, 2018; Fuchs, 2014; Zuboff, 2019). As a result, the understanding of how embedded forms of racialization in technoscientific capitalism are constituted by political economies of AI and data in the Global South remains understudied. Technoscientific capitalism can be defined as a contemporary form of capitalism that is increasingly technoscientific by virtue of its reliance on the development of new technological products and services, emergent technoscientific knowledge production practices such as big data and AI among others, and the alignment of technoscientific innovation practices with powerful 'investment rationalities' and 'financial imperatives' (Birch & Muniesa, 2020, p. 1).

More specifically, the political economy of AI and data focuses on how knowledge production practices around AI and data are impacted by the ethical, social, and political dimensions of economic practices including issues around the distribution of power and wealth in society and how in turn these economic practices are impacted by AI and data knowledge production practices (Bilic, 2016; Birch & Muniesa, 2020; Lee et al., 2015; Luitse & Denkena, 2021; Tyfield et al., 2017; Zuboff, 2019).

One strand of this literature examines embedded forms of AI in the structure of the emerging digital economy where AI technology is woven into the fabric of modern digital systems that power markets ranging from trading systems to assembly lines in factories among many other applications of AI, data, and algorithmic logic (Kiggins, 2017; Luitse & Denkena, 2021; MacKenzie, 2017; Peters, 2017).

Another strand of this literature highlights processes of assetization and capitalization of data among other "things" in technoscientific capitalism and understands this technological shift within a modern capitalist system that is characterized by its increasing reliance on technoscience (Birch & Muniesa, 2020). This literature (Birch, 2017, 2020; Leonelli, 2016; Parayil, 2005; Peters, 2017; Zuboff, 2019) examines the ways in which practices of value extraction and capital accumulation manifest themselves in contemporary technoscientific formations through technoeconomic practices of assetization where the dominant form and organizing principle of technoscientific capitalism is the asset (Birch & Muniesa, 2020). In this literature, data is framed as an asset that can be "owned or controlled, traded, and capitalized as a revenue stream", and as the main form from which algorithmic processes extract value at a market scale through practices of data appropriation, capitalization, rentiership, financialization, and valuation (Birch & Muniesa, 2020, p. 2).

This scholarship from STS and other disciplines (Fuchs, 2010; Langley & Leyshon, 2017; Srnicek, 2016; Zuboff, 2019) attempts to show that markets in technoscientific capitalism are created through the reconfiguration of a wide range of technoscientific objects (human and non-human), including infrastructure, data, knowledge, bodies, as well as human life, and human experience. It also highlights the different forms and processes of value extraction and capital accumulation in technoscientific capitalism. For example, Fuchs (2010) argues that in informational capitalism the exploitation of the commons is a central process of capital accumulation. In surveillance capitalism, Zuboff (2019) argues that this takes place through the exploitation of data and appropriation of human experience in digital platforms. In platform capitalism, Srnicek (2016) argues that this is achieved through the exploitation of both physical and digital labour by altering the means and relations of economic production through digital platforms. For example, Langley & Leyshon (2017) argue that digital platforms introduce new form of value extraction through processes of intermediation and capitalization on digital economic circulation across several 'digital economic ecologies' (social media, online marketplaces, crowdsourcing, crowdfunding, sharing economy, and so forth) and its associated data trails with the goal of these platforms to realize monopoly rents.

A strength of this body of literature is its ability to show the changing nature of contemporary capitalism by demonstrating emerging modes of capitalist production, capital forms, value extraction, and capital accumulation and link them to issues of data ownership, loss of control, and regimes of intellectual property. However, one of the areas that does not receive enough attention in this literature is the link between issues of fairness, inclusion, and equality in contemporary formations of digital technology and the racialized practices of technoscientific

capitalism. Additionally, most of the literature in this area seems to focus more on Western economies and lacks the theoretical and empirical specificities of digital economies of the margins.

2.4.1. Technoscientific Capitalism, Colonialism and Blackness

In this section, I review literature on the links between technoscientific knowledge production practices and capitalism, colonialism, race, and empire to show their interrelated nature and the importance of considering these categories in political economy analysis of technoscience in Africa.

Some of the literature in this area (Braun, 2014; Elshakry, 2016; Foster, 2017; Leroy & Jenkins, 2021; Rosenthal, 2018) attempts to draw attention to the ways in which slavery was constituted by capitalist economic practices and in return slavery practices informed economic practices of capitalism globally and in settler communities. For example, Rosenthal (2018) argues that there is a series of interconnected business histories between current data practices in capitalist enterprises and those of slavery and plantation accounting and management. She argues that economic and businesses management concepts such as productivity analysis, valuation practices, calculations of appreciation and depreciation have connections with slavery plantation management. Rosenthal (2018) argues that, in many ways similar to contemporary capitalism, the transatlantic slavery was a *global enterprise* for capitalism that was extended from Africa to Europe, the Americas, and West Indies.

This literature attempts to link slavery plantation practices to business practices to underscore some of the different ways that profit and innovation accompany violence and inequality in contemporary capitalism, especially in the US. For instance, Rosenthal argues that when planters lost control of the minute details of the lives of freedpeople after the US Civil War,

they re-established economic power and profitability through law and violence. The violence against freedpeople after the abolition of slavery has taken many forms of anti-Blackness through the establishment of surveillance practices against blacks and racialized population in the US.

Some of the surveillance literature (Braverman, 2014; Browne, 2015; Introna & Nissenbaum, 2010; Lyon, 2007; Sevignani, 2017) links surveillance practices to histories of anti-Blackness and discrimination against racialized people. For example, Browne (2015) argues that blackness was 'a key site through which surveillance is practised, narrated, and enacted' (p. 9). She explains that the historical formation of surveillance in the US is linked to the formation of slavery as evident by the historical records on plantation rules, narratives of ex-slaves, runaway slave notices, and census practices. Additionally, surveillance studies literature (Braverman, 2014; Introna & Nissenbaum, 2010; Lyon, 2007; Sevignani, 2017) has examined the historical links between slave surveillance, surveillance after the abolition of slavery, and modern surveillance practices including those in digital technology.

In fact, there is a growing interest in crosspollination between the fields of critical security studies (CSS) and STS (Bellanova et al., 2020). More specifically, Black STS scholars such as Benjamin (2019a) and Bonilla-Silva (2009) use Browne's (2015) notion of "racialized surveillance" to examine sociotechnical practices of surveillance on digital platforms highlighting new forms of anti-Blackness in terms of notions of colour-blind racism or racism without races arguing that anti-Blackness is the precondition for the fabrication of such digital technologies. Browne (2015) extends the general understandings of surveillance in the literature by defining the concept of racialized surveillance as a technology of social control that produces norms about race and the exercise of power and establishes or reinforces social relations, structures and institutions in ways that privilege dominate groups and oppress other marginalized groups (Browne, 2015, pp.

16–17). This is important because the way things get ordered racially by surveillance practices does not only reinforce negative strategies from colonialism and slavery but also produces inequalities and reinforces asymmetries of wealth and power as a result of discriminatory treatment of groups that are negatively affected by the outcome of embedded surveillance practices in formations of digital technologies including AI and data .

Additionally, there is emerging literature (Couldry & Mejias, 2019b; Poster, 2019; Sevignani, 2017; Zuboff, 2019) that shows the constitutive relation between surveillance and economic practices in contemporary political economies of AI and data. According to its critics, surveillance capitalism introduces new forms of value extraction and capital accumulation through the appropriation of human life and human experience (Couldry & Mejias, 2019b; Zuboff, 2019). On the other hand, there is a body of literature linking surveillance data practices to colonial practices around resource appropriation and subject formation (Couldry & Mejias, 2019a, 2019b; Phan & Wark, 2021; Thatcher et al., 2016). This literature attempts to show the constitutive relation between race, colonialism, and forms of digital capitalism. Digital capitalism is a term that recognizes the genealogy of capitalism and can be characterized by contemporary capitalist modes of production that rely on digital technology including AI, data, and network connectivity (Karar, 2019). In this dissertation, I understand digital capitalism as a form of technoscientific capitalism that employs digital technologies.

For example, scholars such as Couldry & Mejias (2019b) and Thatcher et al. (2016) link sociotechnical and socioeconomic practices of digital platforms and big data to colonial practices embedded within practices of digital capitalism such as naturalization of data capture, and new modes of extraction, dispossession, and data commodification. They bring attention to new forms of value alienation and exploitation underpinned by digital data logics. According to Couldry &

Mejias (2019a), through processes of data relations, as an emerging social form of human relations enabled by data as potential commodity, new mode of colonialism (i.e. data colonialism) is enacted by big data and digital platforms that are dependent on the normalization and exploitation of humans through data in similar ways to historical processes of colonialism in its appropriation of territory, resources, and ruled subjects for profit. Couldry & Mejias (2019a) argue that processes of data relations are influenced by ideas of European modernity such as absolute universal rationality that are reproduced in data colonialism through 'its logics of universal data extraction and management of human beings through data' (p. 346).

This understanding of technoscientific capitalism through the lens of Blackness, which I discuss in more details in the next chapter, opens up ways to examine how contemporary technoscientific knowledge production might be implicated in the project of empire and how new genealogies of Empire might be demanding a recast of the relationship between the margin and metropole. In the next section, I discuss genealogies of empire and provide an overview of how enduring forms of imperial practices in contemporary technoscientific capitalism are discussed in some of this literature. This overview provides an understanding of the dynamic and evolution of centre-periphery relation which is an important consideration when examining issues of technology and innovation dissemination from the Global North to the Global South.

2.4.2. Technoscientific Empires

The literature from both historians of science such as Baker (2009), Elshakry (2010, 2016), Hodge (2011), Poskett (2021) and STS scholars such as Goss (2021), Haraway (1990), Roberts (2013) and Stoler et al. (2007) examines the constitutive relation between race, technoscience and empire and shows that through technoscience and race as a political classification system, the

project of empire becomes possible. For example, Elshakry (2016) argues that race as a sociopolitical classification system is linked to modernity and coloniality which both have been characterized by expansionist power.

Similarly, Roberts (2013) argues that race, as a category, is a recent phenomenon that was framed as a natural occurrence three centuries ago by European naturalists in order to justify conquests and enslavement of others, creating a justifiable basis for difference and othering to advance the interest of specific groups of society (p. 151). On the other hand, Elshakry (2010) argues that the expansion of Western power, Europe's military and technological supremacy, is often seen as evidence of the efficacy of the Western sciences, while in fact, is linked to several forms of institutional appropriations that enabled the amalgamation of older forms of knowledge into new conceptions of Western science (Elshakry, 2010, p. 100). She argues that "the global emergence of the idea of Western science highlighted key questions pertaining to the relation of the history of science to knowledge traditions across the world and the continuing search for global histories of science" (Elshakry, 2010, p. 98).

However, imperial technoscience practices outlived colonialism into the twenty-first century and continue to persist in contemporary formations of technoscientific capitalism, according to Jasanoff (2006). For example, she argues that biotechnology and biological sciences are enrolled in multiple modalities of empire through 'bottom-up resistance, top-down ideological imposition, administrative standardization, or consensual constitutionalism' (p. 292). She argues that technoscience is involved in empire making through various practices of imperial governance and outlines five modalities of imperial governance through which the heterogeneity of Empire is organized and controlled.

According to Jasanoff (2006), these modalities include empire of resistance, empire of ideology and force, empire of legibility, empire of identity, and empire of law and constitutions. She defines empire of resistance by 'emergent, agentless form of rule, constituted in possibly violent opposition between global ruling institutions and resisting citizens' (Jasanoff, 2006, p. 277). She explains that empire of ideology and force is characterized by imposing communal norms and beliefs through force, persuasion, surveillance, and sanctions, while empire of legibility imposes communal standards through Weberian means such as administrative simplification and efficiency or Foucauldian practices (Foucault, 1994) such as classification, normalization, and erasure. In addition, she defines empire of identity as forming 'imagined communities built through mass media, official representations, political and cultural symbols' (p. 277). Lastly, Jasanoff (2006) characterizes empire of law and constitution by establishing rule of law through constitutional principles to enable liberal individualism and free movement of goods and people.

Jasanoff's (2006) conceptualization of empire making is rooted in STS traditions and offers a way to understand how knowledge production practices could be implicated in empire making. On the other hand, Fuchs (2016) takes more of a classical political economy approach to analyze empire making in digital capitalism through the lens of the international division of labour. He argues that the structure of contemporary imperialism is built on the international division of labour in the production of information and communication technology. Fuchs (2016) argues that digital labour is essential for capitalist innovation and exploitation in the information industries of today where hyper-industrialization and a range of technoeconomic activities constitute contemporary imperial capitalist practices. According to Roberts (2013), this is facilitated through international intellectual property and patent laws as well as methods of valuation and financialization of technological innovation that are connected to the global financial markets and

provide the complex infrastructures of legal frameworks that set the boundaries for scientific research and govern the diffusion of technological innovation in technoscientific capitalism.

This discussion demonstrates that the enterprises of technoscience have been central to imperial projects since early modernity, colonialism and into contemporary capitalism. In this dissertation, I look at the political economy of AI through the lens of Empire to open up ways to see how the entanglement of AI technological development and scientific research with the commercial objectives of multinational corporations may be in many ways implicating scientific knowledge production and technological innovation in new forms of imperial practices of global technoscience projects. For example, the idea of the globalization of digital technologies and the search of digital capitalism for new markets on the global stage (universal Internet connectivity, big tech and transnational technoscience enterprises, cross-national mergers, acquisitions, takeovers and so forth) may have their roots in the colonial history of science and technology and the understanding of "Western technology" as universal and global technology.

At the same time, careful consideration for what constitutes imperial practices of multinational corporations is required as it is not easy to always distinguish them from other forms of globalization that are enabled by different technologies and networks of production, consumption, distribution, and communication than those of imperial production and exchange. As Stoler et al. (2007) argues, imperialism is not globalization. However, what this discussion shows is that certain features of earlier imperial forms such as transnational connectivities and historical inequalities generated by earlier phases of imperialism and colonial legacies surrounding racial categories are recuperated in technoscientific capitalism and follow traces of past imperial circuits.

In summary, while the broader literature in the political economy of technoscience on data appropriation and exploitation such as (Birch & Muniesa, 2020; Madianou, 2019; Zuboff, 2019) shows the evolving nature of contemporary capitalism, however, the impact of the racialized social environment in which technoscientific capitalism operates and the marginalization of global epistemic communities remains undertheorized in this literature. I argue that looking through the analytical lens of race and anti-colonial theories and their connection with economic practices around technoscience opens analytical and theoretical possibilities for a different theorization of AI and its economic practices in contemporary digital formations from the South, which I discuss in more details in the next chapter. However, before I move to that discussion, I first review the literature on AI in Africa to understand how AI development is taken up by different social actors in the continent.

2.5. Artificial Intelligence and Innovation in Africa

In this section, I turn my focus to a review of the state of knowledge about AI in Africa while outlining some of the gaps in the literature in this area. I discuss relevant scholarship by African scholars that highlights some of the major debates and controversies influencing the development of AI and shaping the ideas and visions about technoscientific futures in the continent. The purpose of this review is to show how the benefits and risks of AI has been discussed in this literature and the implications for sociotechnical and economic practices of AI in the continent.

There is a dearth of literature examining the social implications of AI or looking at AI and the broader ICT as an economic practice in Africa (Graham, 2019; T. Ojo, 2018; Wall et al., 2021). As a result, the social and economic implications of ICT including AI remain understudied in the

African context. The literature I discuss in this section, focuses on AI ethics, governance, development, innovation, and knowledge production in Africa. I argue that most of this literature contains normative claims about the positives and negatives implications of AI dissemination and innovation practices in the continent and lacks the understanding of the political dimensions of technological innovation in the continent. In what follows, I present the major strands of this literature and discuss its weaknesses and strengths.

2.5.1. A Panacea for Development or Predicament of Domination?

In response to the growing interest in the implications of AI for Africa's long-standing social and economic challenges, there has been an increase in the literature on the burgeoning area of Artificial Intelligence for Development (AI4D). This literature (Gwagwa et al., 2021; Kiemde & Kora, 2020; Mann & Hilbert, 2020; Wall et al., 2021) offers normative and instrumental view on the social and economic implications of AI technology with the main question being how AI impacts economic and sustainable development while addressing social justice in Africa. This literature tends to focus more on the application of AI and the role that AI can play in the socioeconomic development of the continent with less critical view on the agency of the local population, role of the state, and multinational corporations.

One strand of this literature offers instrumental view of AI and discusses different approaches for developing AI solutions in the continent in many areas including agriculture, health, energy, education, commerce, law, and African languages (Adeoye et al., 2022; Forkuor et al., 2017; O. O. Ojo, 2021; Zhuo et al., 2021). For example, Forkuor et al. (2017) attempt to advance the use of remote sensing in data collection for spatial soil information and digital soil mapping as opposed to traditional soil mapping approaches in order to deal with the high cost and

effort in collecting accurate data for AI modelling of soil information in West Africa. They argue that this is an important area because of its application for monitoring the effects of climate change, droughts, land degradation, soil fertility, farming, and agriculture. Another example is an emerging body of literature (Mabrouk et al., 2021; Siminyu et al., 2020) that discusses different approaches for developing AI models for African languages using natural language processing (NLP), a machine learning technique for language and speech recognition. However, like many other AI applications in the continent, a major challenge is collecting reliable data sets that can form a corpus that allows these applications to produce accurate, useful, and meaningful results.

Another strand of literature discusses AI impact on innovation practices in the context of the fourth industrial revolution (4IR) in Africa (Jegede & Ncube, 2021; Madden, 2020; Ndung'u & Signé, 2020; Nyagadza et al., 2022). This development should be understood within the wider trends and practices of technological innovation in the continent. The fourth industrial revolution is a term used to describe a paradigm shift in capitalist mode of production that is caused by the deployment of cyber-physical systems and the ubiquitous connectivity of billions of people and things such as sensors and a plethora of data sources and digital objects from mobile phones to cars and so forth, also known as the "Internet of Things" (Schwab, 2017). This shift employs current technological advances in AI, connectivity, and data. Most of the literature on the 4IR takes a normative view with much focus on the economic benefits of this technological shift and the implications for technoscience and innovation policy in the continent. For example, Jegede & Ncube (2021) propose a path that is similar to Western global innovation practices to prepare Africa, and South Africa in particular, for the 4IR. They propose an approach that includes foreign direct investment inflows, trade of technology-intensive products, acquisition of external technologies, reverse engineering, and research and development consortia. Jegede & Ncube

(2021) argue that these strategies are best business practices that have been tried globally and successfully dealt with issues of increased automation, labour market disruptions such as loss of low-skilled/labour-intensive jobs to highly skilled/knowledge-intensive jobs, rapid digitalization, and shifts toward machines, robots, software, data, and so forth. They recommend several policy moves to strengthen Africa's position in the 4IR including the intensification of linkages and interactions among key actors in the African innovation ecosystem, establishment of innovation system approach, and greater coordination among internal and external resources in terms of funding, R&D, direct investment, and so forth. Similarly, Nyagadza et al. (2022) argues that the key challenge for emerging economies is the ability to engage themselves into dynamic global value chains, which is the approach suggested by Jegede & Ncube (2021).

On the other hand, critical literature from African scholars links contemporary AI innovation practices to new forms of digital colonialism practised by Western multinational corporations in order to increase capital accumulation and wealth concentration within big tech and corporate monopolies (Birhane, 2020; Kwet, 2018; Madianou, 2019; Oyedemi, 2019). This literature is concerned with the deployment of technological innovations practices as a new form of domination, power, and control using algorithmic logic for profit maximizing at any cost including the appropriation of human soul, behaviour and action (Birhane, 2020). This literature challenges AI4D projects and sees them as a new form of Western exploitation and hegemony (Birhane, 2020; Coleman, 2019; Kwet, 2018; Madianou, 2019). According to Birhane (2020), this new form of Western invasion of Africa is driven by corporate agendas through the development of algorithmic solutions to social problems while simultaneously weakening the development of local products and increasing the dependency of the continent on Western software and infrastructure. As D. Coleman (2019) argues, this interest is seen as the "modern-day scramble for

Africa" under the guise of altruism where big tech and other Western corporations gain access to untapped data on the continent using their power and resources while taking advantage of the scant data protection laws. For example, Oyedemi (2019) argues that through practices of benevolent capitalism, big tech such as Facebook pursues market domination in Africa through infrastructure investment in Internet connectivity taking advantage of the lack of investments in this area by sovereign African governments or national capital and low penetration rates in the continent.

In this section, I showed a range of literature discussing the implications of AI innovation practices in Africa (Hilbert, 2016; Lee et al., 2015; Luitse & Denkena, 2021; Mann & Hilbert, 2020; Wall et al., 2021). This literature is concerned with the risks and benefits associated with the dissemination of AI innovation and its application for economic development and social change. In the next section, I discuss some of the literature that attempts to address the ethical dimensions of AI development to minimize the harms and increases the gains of AI through the development of responsible AI in the continent.

2.5.2. Responsible AI Through African Lens

There is growing set of literature attempting to frame AI development and ethics from an African perspective by looking at the particularities of AI implementation in the African context (Carman & Rosman, 2021; Nandutu et al., 2021; Wairegi et al., 2021). For example, Wairegi et al. (2021) argue that AI development will unfold differently in Africa given its geographical, cultural, and political landscape, and as such they proposed a stakeholder framework that maps and characterizes all parties involved in the development of AI in the continent in order to understand who wins and who loses in such development.

On the other hand, an emerging body of literature (Gwagwa et al., 2022; Kiemde & Kora, 2021; Mohamed et al., 2020; Peña1 & Varon, 2019) attempts to engage more with the racialized and colonial nature of AI from Global South and African perspectives. This literature offers some ideas in terms of how to approach AI from the vantage point of marginalized communities in the Global South, and particularly Africa. It examines AI ethics and governance from an African perspective and offers some ideas and approaches for the development of AI ethical frameworks that challenge dominant Western ethics approaches and are rooted on African knowledge production practices. For example, Mohamed et al. (2020) argue for the use of decolonial theory as critical science and to focus on values and power in AI. They see this as its two critical pillars from which to establish ethical principles while centring vulnerable communities in the Global South and elsewhere. Mohamed et al. (2020) argue that this is critical to develop foresight and tactics that can reduce the negative impact of technological innovation on these communities.

Others such as Carman & Rosman (2021) and Gwagwa et al. (2022) look at developing different AI ethics approach by integrating African value systems such as Ubuntu into AI ethical frameworks. Ubuntu is an African indigenous culture of sub-Sahara that existed for centuries and 'refers to respectful treatment of all people as sharing, caring, and living in harmony with all creation' (Chuwa, 2016, p. 1). The core idea of Ubuntu is that a person exists as a person through others which constitutes the concept of personhood in Ubuntu culture, hence the emphasis on values such as care, togetherness, solidarity, cooperation, generosity, hospitality, friendliness, and so forth.

However, Ubuntu has been framed in many different ways in both popular and academic discourse such as an African moral philosophy, alternative ethical framework, value system, and knowledge decolonization approach, to name a few approaches to the notion of Ubuntu (Brás,

2021; Naude, 2019). Particularly, Ubuntu ethics have been mobilized in many fields including social work (Mugumbate & Nyanguru, 2013) and bioethics (Chuwa, 2016; Ujomudike, 2016), and now it is making its debut into AI ethics (Coeckelbergh, 2022; Gwagwa et al., 2022; Mhlambi, 2020). For example, Gwagwa et al. (2022) propose key principles for AI ethics based on Ubuntu philosophy to balance the benefits and risks of AI. This includes the creation of an AI African values system that can align and inform AI knowledge production practices, integration of principles of equity and inclusion into AI practice, and the adoption of community co-creation or co-design as a way of building inclusive AI partnerships. They advocate for the integration of this code of AI ethics with disciplines from the social sciences and legal sciences. Gwagwa et al. (2022) emphasize that this approach rests on political commitment and strong value proposition at the public policy level to eliminate or minimize the potential harm of AI technology in Africa and create an AI policy that is driven by ethical and sociocultural considerations of African communities.

However, the implementation of such ethical frameworks could very challenging in the continent, according to Kiemde & Kora (2021). Kiemde & Kora (2021) propose an approach to overcome the difficulty in implementing ethical and responsible AI proposals by researchers from Africa and the diaspora. According to Kiemde & Kora (2021), the implementation of AI ethics in Africa can be enhanced by the integration of ethical concepts in the training of practitioners, researchers, and other actors involved in the development of AI in the continent. They propose the introduction of AI ethics courses in academic training and capacity building based on African ethical values and diversification of AI teams.

On the other hand, Bjola (2021) outlines four major areas of AI for development that need to be examined and have implications for theory and practice. These include learning to access

and combine data from multiple sources to get accurate results, selecting the appropriate and most relevant AI technique to get useful analytical insight, employ interdisciplinary approach to develop solutions with social impact, and applying AI in ethical and responsible manner. He proposes two research strategies, one is focused on examining how well development concepts and theories capture and respond to the scope of AI practices including the digital and outlining its gaps. The second is to take a critical perspective on the normative concerns and claims about the social and economic impact of AI. Bjola (2021) points out that despite the rise in AI discourse for development, on the practical side, AI applications still face many challenges including technological feasibility, performance, integration, and reliability as well as lack of relevant data sets and policies. Similarly, Kiemde & Kora (2020) outline four major areas of challenges for AI development in the continent including data, education, public policies, infrastructure. These areas are discussed in more details throughout the empirical chapters.

In this section, I discussed the literature by African scholars on AI ethics and showed that there are attempts to challenge utilitarian and instrumental thinking and other forms of Western rationality in AI. There are also attempts to challenge universal AI approaches that exclude and discriminate against AI development visions that do not measure up to Western rationality. Some of these intellectual projects attempts to seek an alternative knowledge production system based on Indigenous cultural systems such as Ubuntu that can inform AI sociotechnical practices in the continent. However, many challenges still exist to translate these ethics proposals into a set of normative ethics practices that can be embedded into AI-based solutions in the continent. For example, Africa is a vast heterogeneous continent with diverse social, cultural, political, and economic structures which make the notion of a universal African value system that can be embedded into AI ethics and public policy in the continent is an unattainable undertaking.

Furthermore, Ubuntu ethics are articulated using Western knowledge categories such as ethics, epistemology, cosmology and so forth. Kiemde & Kora (2021) point out to the occidental nature of the concept of ethics itself. In addition, Western categories take universalist approaches to knowledge production, which are highly criticized in STS because of their tendency to oppress situated knowledges and standpoints. In this sense, Naude (2019) asks the question of whether Ubuntu ethics can save us from coloniality. As Naude (2019) argues, despite the substantive effort and strong form of decentring Euro-American centric views by Ubuntu ethics. However, the epistemic decolonization by the Ubuntu project is steeped in Western knowledge forms and rules of validation of theoretical scientific knowledge. From this perspective, Ubuntu ethics may be seen as perpetuating and reinforcing a colonial mindset, according to Naude (2019).

2.6. Conclusion

In this chapter, I discussed the notion of co-production of technoscientific knowledge and social order and showed that the sociotechnical imaginaries framework as a co-productionist approach expresses clear commitment to investigating world making ideas that are linked to technoscience and innovation. I argued that the sociotechnical imaginaries as an analytical approach lacks the adequate consideration for the racialized structures and economic environments in which technoscience and innovation emerge. I reviewed the literature on the raciality of technoscience and discussed the different approaches of racial analysis in computing and AI. I also reviewed the literature of the political economy of AI and discussed the constitutive relation between capitalism, technoscience, race, and empire. I then discussed how the social and economic implications of AI are taken up by African scholars and how the risks and benefits of AI development are articulated in the AI ethics literature and AI4D.

My main argument is that most of the literature on the social, political, and economic implications of AI is oriented towards Euro-American perspectives, knowledge production practices, and Western philosophies and ethics of AI and lacks the consideration for how AI development in understood by African actors in the continent. In the next section, I integrate this discussion with contemporary African studies scholarship on decoloniality, understandings of Blackness in technoscientific capitalism, and African modernities to theorize AI development from Africa. I develop an analytical view to understand African technoscientific visions of the future and their articulations in the world. I use this analytical framework to answer the research questions of this dissertation.

3. Theoretical Framework: Black Technoscientific Discourses of Modernity

3.1. Introduction

In the previous chapter, I reviewed three strands of literature from science and technology studies (STS). This literature review discussed the political, racial, and economic dimensions of technoscience and innovation and offered perspectives that are relevant to this dissertation project. I argued that while these aspects of technoscience and innovation are widely discussed in the literature, however, most of this literature particularly in STS is focused on the Euro-American context and lacks the understanding of technoscience and innovation in the Global South, and more specifically Africa.

In this chapter, I develop the concept of *Black Technoscientific Discourses of Modernity* to examine contemporary technoscientific visions of African people in Africa and the diaspora about the role of technoscience in progress and development in Africa. I use this concept to look at how digital technologies and specifically AI are reconfiguring the debate about development and modernization in Africa and in turn how political ideas about development and modernization in Africa are influencing technological development and innovation focusing on AI technology in the African context. In the literature review chapter, I discussed the theoretical concept of sociotechnical imaginaries, raciality of technoscience, and the political economy of technoscience which I build on them in this chapter and integrate other key ideas from African studies to develop the concept of Black Technoscientific Discourse of Modernity.

I define the concept of *Black Technoscientific Discourses of Modernity* as a collection of ideas, visions, and knowledge production practices that are influenced by Africa's colonial history, racial exclusion, capitalist extraction, and structural disparities of Africa's political economies of technoscience and innovation, and informed by lived experiences in the margins that are shaping

and shaped by the multiplicity of sociotechnical imaginaries of Africa and situated technoscientific practices. This theoretical concept is built on three key ideas including theory from the South (Comaroff & Comaroff, 2011), the critique of Black reason (Mbembe, 2017b), and the co-production of African futures (Jasanoff, 2004). In the next sections, I first present each one of these ideas and then discuss the notion of Black Technoscientific Discourses of Modernity in more details outlining its analytical aspects that I use later in the analysis of the data collected for this project.

3.2. Theory from the South

The idea behind *Theory from the South* (Comaroff & Comaroff, 2011) is an attempt to challenge universalist thinking in Western social theory and revisit the notion that Western modernity, since European enlightenment to modernization and development discourse, has been seen as a true original model for measuring progress (Hanchard, 1999; Mahmoud, 2015). It is an attempt to recast other modernist processes in the South as legitimate knowledge production practices with deep historical roots and traditions of knowledge making and ways of knowing (Connell, 2007; Hassan, 2010). This debate is happening in the backdrop of increased shifts and reconfigurations of research funding, information flows and globalization trends of technological development and innovation practices where South-based research centres are trying to counter the view that frames them as only conforming consumers of knowledge and assert their role with much greater agency (Haug et al., 2021).

In this section, I focus on Comaroff & Comaroff's (2012) provocation in their *Theory from the South*. This is relevant to this dissertation because it is an attempt to understand the entanglement of globalization, capitalism, and modernization from a Southern perspective while

theorizing alternative modernities from the margins. The central idea in *Theory from the South* is that 'in the present moment, it is the so-called Global South that affords privileged insight into the workings of the world at large' (Comaroff & Comaroff, 2012, p. 114).

There are two interwoven arguments put forward by Comaroff & Comaroff (2012) for the notion of *Theory from the South*. The first is that modernity can be narrated from its undersides as it can from its proclaimed Centre. From this vantage point, the second argument is that the Global South might not be trailing the curve of 'Universal History' and playing catchup to Euro-America, according to Comaroff & Comaroff (2012). Conversely, it is the Global South that offers the insights into the functioning of contemporary world-historical processes and the making of modernity. Comaroff & Comaroff (2012) argue that globalization processes are not only shifting the received geographies of the centre-margin by increasingly relocating modes of value production, but they are also changing the driving pulse of contemporary capitalism in its both material and cultural formation southward.

According to Comaroff & Comaroff (2012), the entanglement and mutual dependency of the South-North economies is the defining feature of globalization and contemporary capitalism with its exploitative capabilities on the working class on both Euro-America and the South. This problematization of the relation between the Global South and Global North is further complicated by their provocation that 'Euro-America is Evolving Toward Africa'. Comaroff & Comaroff (2012) argue that 'regions in the south tend first to feel the concrete effects of world-historical processes as they play themselves out, thus to prefigure the future in the former metropole' (p. 121). They contend that many of the financial operations such as structural adjustments and austerity measures that are informed by contemporary capitalism and trends of neoliberalism that have been tried and tested in the South are now being reimported to various Euro-American

locales. Euro-America is experiencing the same fiscal meltdown, state privatization, corruption, and ethnic conflicts that long characterized the Global South, thus, in many ways, the Global South resembles the future of Euro-America, according to (Comaroff & Comaroff, 2012, p. 122).

In this case, neoliberalism is understood by Comaroff & Comaroff (2012) as a phase of capitalism that intensified at the start of the millennium and can be characterized by a set of cultural and economic practices that intensifies processes of decontextualization (separation of place from its sociomoral pressures), and abstractions inherent in capitalism such as the separation of labour power from its human context, replacing society with the market, and building a universe out of aggregated transactions that understand 'persons not as producers from a particular community, but as consumers in a planetary marketplace', and frame 'persons as ensembles of identity that owe less to history or society than to organically conceived human qualities' (Comaroff & Comaroff, 2001, p. 13) .

On the other hand, the rise of economic powerhouses in the South and the decentring of Euro-America are opening up new possibilities of self-fashioning and different material and cultural formations in the margins. According to Comaroff & Comaroff (2012), the rise of new economic powerhouses from the South such as India, China, Brazil, and South Africa threatens to destabilize Western dominance, and in many ways, opening up new possibilities of their own to form new spaces of material relations and begin to colonize the metropole. They point out the growing relationship between China and Africa as they are attempting to map out a path for the present and future of two large regions of the South. They also point to the ascent of China and India as the world production houses with advanced facilities that are no longer located in Euro-America, although Euro-America still reap substantial amount of the super profit (Comaroff & Comaroff, 2012, p. 117).

From this perspective, Comaroff & Comaroff (2012) see that modernity has always been and can be understood as a South-North collaboration and world-historical process, despite histories of asymmetries that characterize the South-North relation and efforts by the West to purify modernity by placing the 'Other' outside (Said, 1979). Nevertheless, they point out that despite decades of postcolonial critique of modernity, the South continues to be measured up against the North in modernist social theory. However, Comaroff & Comaroff (2012) contend that what is understood to be modernity, as something that disadvantaged people and the South was deprived of its promise, is in fact something the margins can simultaneously challenge and make their own version of it.

From this perspective, Comaroff & Comaroff (2012) propose *Theory from the South* as a way to empirically and theoretically have a firm grasp of the history of the present, at least in major part (Comaroff & Comaroff, 2012, p. 117). This move suggests a theoretical reorientation that does not define the so-called, *Global South*, as a priori but rather as a signifier that speaks of a relation that its content is determined by everyday material and political processes as a result of globalization practices.

3.3. Critique of Black Reason

Mbembe (2017) theorizes *Black Reason* as a collection of discourses, practices, and forms of knowledge that provided the justification for racial domination by equating Blackness with the non-human. According to Mbembe (2017), Black reason is founded on two ideas. First, *Western consciousness of Blackness* which consists of a set of knowledge practices and interpretations that serve as the rationality to produce the Black man as a 'racial subject' and 'site of savage exteriority' that is disqualified of morality and can be used for practical instrumentality. Second, *Black*

consciousness of Blackness which consists of a set of literary forms, political struggles, historical narratives, and global network relations that contributed to the creation of the modern Black imaginary. According to Mbembe (2017), the Black consciousness of Blackness was first conceived in Euro-America and the Caribbean and later in Africa by people, often in motion between continents and participating in the cultural, political, and intellectual life of Euro-America and the globalization trends of their time. It was the product of a long history of acts of emancipation, radicalism, anarchism, internationalism, and resistance against slavery, segregation, capitalism, colonialism, imperialism, and all forms of domination, carried forward by humanitarian and philanthropic undercurrents that attempt to lay the foundation for a different genealogy of human rights, as Mbembe (2017) argues.

Critique of Black Reason should be understood within the context of Mbembe's work on decolonization (Mbembe, 2019, 2021) which traces the genealogies of the term and its many trajectories in modernity that resulted in reducing decolonization in most current debates in both public and academic discourse to, a simple transfer of power from the metropole to former colonial possessions and no longer referring to the "complete overthrow" of colonial structures, institutions, and ideas of Western modernity, as Mbembe (2021) puts it. Mbembe (2017) reads Black reason with histories of slavery, colonialism, and racial capitalism that constituted the making of modernity. On one hand, Mbembe (2017) argues that the conflict over Blackness has been inseparable from the question of modernity. This has manifested itself in the way in which the relation of man to the animal and reason to instinct is understood within certain traditions of Western metaphysics, therefore, the expression of Black reason refers to a collection of deliberations about this distinction, according to Mbembe (2017). In addition, he points out that Black reason also includes technologies of submissions to regulate the animality within the Black

man such as laws, regulations, rituals, and so forth. According to Mbembe (2017), Black reason simultaneously identifies many things including 'forms of knowledge; a model of extraction and depredation; a paradigm of subjection, including the modalities governing its eradication; and, finally, a psycho-oneiric complex'. For Mbembe (2017), Black reason is 'like a kind of giant cage', 'a complicated network of doubling, uncertainty, and equivocation, built with race as its chassis' (Mbembe, 2017b, p. 10).

On the other hand, Mbembe (2017) contends that Blackness and capitalism have evolved together in many ways. According to Mbembe (2017), there are three key moments in the relation between Blackness and capitalism. The first was the Transatlantic Slave Trade and the dehumanization of Blacks, converting them into *human-commodities*, *human-money, human-objects (man-merchandiz*e, *man-of-mone*y*, man-of-metal*). The second came at the establishment of common language for the struggle for freedom that emerged out of the Haiti slave revolt, the struggle for independence, civil right movement in the US, and the dismantling of Apartheid in South Africa. The third is the current moment of neoliberalism, which, he argues, marks the globalization of Blackness. According to Mbembe (2017), this is another phase in the relation between Blackness and capitalism, where the term Black has been generalized and institutionalized as a new norm of existence and expanded to the entire planet for the first time in history. Mbembe (2017) points out that by neoliberalism he means 'a phase in the history of humanity dominated by the industries of Silicon Valley and digital technology' (Mbembe, 2017b, p. 3). While Comaroff & Comaroff's (2001) conception of neoliberalism connects the cultural and economic aspects of the evolving nature of capitalism at the millennium, Mbembe's (2017b) understanding brings attention to the ways in which contemporary capitalism equates the human with the non-human through data practices and digital technology of big tech.

According to Mbembe (2017), while earlier conceptions of Blackness are understood within the context of the transatlantic slave project where slavery constituted one of the most violent forms of human labour appropriation in early capitalism, however, the current moment of neoliberalism represents another phase in the co-evolution of race and capitalism that requires new understanding of Blackness that Mbembe calls the *becoming-black-of-the-world*. He argues that the Black condition has become something of a global one and embedded in the different ways contemporary capitalism operates within many spheres including the digital. According to Mbembe (2017), this fusion of capitalism and digital technologies produces new subject apprehended by feelings of increased global social volatility and characterized by Blackness as a new norm of global existence that seeks to regulate their behaviour according to market norms and conditions. Mbembe (2017) see this new subject is different from the 'tragic and alienated figure of early industrialization' (p. 4). He characterizes this new subject as "neuroeconomic", suffering from the duality of the market and nature. Mbembe (2017) argues that this new subject is absorbed by double concerns: *human-thing*, *human-machine*, *human-code*, and *human-in-flux*, constantly adjusting to neoliberal practices of the market and seeking to be protected, spared, and preserved from the tendencies of neoliberalism, and for that matter capitalism, to render humans dispensable in the pursuit of maximizing profit. According to Mbembe (2017), capitalism itself is anti-human, its goal is to replace the humans and making them *superfluous*. In another word, capitalism is riddled with phobic tendencies towards humans where capitalism can be looked at the very least as anthropophobic, as Mbembe (2017) puts it.

For Mbembe, it is important to look at Black reason and decolonization in the context of globalization. Mbembe (2021) argues that colonization was a planetary project largely driven by nation states and national business companies aimed at relocating and extracting the earth

resources by those who had the most advanced technological advantage; therefore, decolonization is, by definition, a planetary project. Through this conceptualization of the relation between Blackness, modernity, contemporary capitalism, and digital technology, Mbembe (2017) deconstructs the template for new forms of exclusion through the lens of colonial and racial analysis by showing how capitalism has always equated Blackness with the non-human, and how in the current moment of digital capitalism that the same inherit processes and practices of capitalism are being reconfigured, extended, and deployed to institutionalize Blackness as a new norm of global existence, as Mbembe (2017) argues. From this perspective, the decolonial project can be understood as a project that has always been, and still is, about restoring our common humanity (Fanon, 2008; Mbembe, 2021).

3.4. The Co-production of African Futures

In this section, I attempt to think through the notions of co-production and sociotechnical imaginaries (Jasanoff, 2004; Jasanoff & Kim, 2015) discussed in the literature review chapter with ideas of decolonization and African modernity in the context of Black technoscience. Traditionally, the study of the margins has been dominated by modes of descriptivism and presentism relying on different ways of narrating life-forms on the margins using anecdotes, negative statements, or statistical indices, as Mbembe (2021) argues. These studies attempt to measure the gap between the metropole and the periphery and always producing versions of what the margins *are not* but never a version of what the margins *actually are*. Therefore, to think of the Black Technoscientific Discourses of Modernity is to try to find another way to think philosophically about the margins in various ways that co-produce the margins from the margins.

From this perspective, the notion of the co-production of African futures demonstrates how future visions of particular social orders in Africa are produced with technoscience and innovation and in return how technoscience and innovation including digital technology and AI are influenced by the political ideas underpinning these future visions. In the Black technoscientific discourse of modernity, these different African futures are expressed through the articulation of different sociotechnical imaginaries of Africa. Imaginaries of the future in Africa are conceived and produced as a constellation of ideas and visions in perpetual reconfiguration and shifting. They are multiple, contradictory, and in many ways in divergent forms but they always gesture toward self-determination, liberation, and rupture with the past and present attempting to chart a path with a particular consciousness toward a different future in Africa. There are two contrasting, yet intertwined, developments driving contemporary discourse of modernity and its various sociotechnical imaginaries of Africa. The first is the globalization of technoscientific capitalism and practices of technological innovation. The second is an urgent need for a new vision of a world where the power of the West is declining, and Euro-America is no longer the centre of the universe, despite how technoscientific capitalism, as a Euro-American model of progress, is increasingly becoming entrenched in different geographies.

From this perspective, the co-production of African futures can be understood as an act of self-fashioning. Comaroff & Comaroff (2012) timely argue for a different position for theory from the South pointing out that the South is in the process of writing its own history and fashioning its own versions of modernities (Eisenstadt, 2000) where new questions are emerging from below. This act of self-fashioning is a form of articulation of all the inequalities that existed between the centre and the margins and reorientation of the understanding of modernity by treating ‘modernity as a concrete abstract’ (Comaroff & Comaroff, 2012, p. 120). On the other hand, African

modernities, as self-fashioning project, is not a derivative or counterfeit of Euro-American modernity nor it is part of a universal enlightenment of European civilization social construct, as Comaroff & Comaroff (2012) put it. African modernities have deep and rich history and their own long trajectories, as argued by many scholars (Comaroff & Comaroff, 2012; Eisenstadt, 2000; Hanchard, 1999; Womack, 2013). This is not a maneuver to ignore the inequalities and injustices that exist in global formations of contemporary capitalism, but rather a theoretical reorientation to avoid denying Africa, its existence out of the gate.

Therefore, the project of African modernities requires epistemological decolonization to centre the political imaginations of Africans in the discourse of the future in Africa. In another way, there is an urgent need to decolonize future-making. This requires different understanding of many of the categories that are used to analyze and understand Africa including colonization, decolonization, and even science, technology, and innovation. This also needs to challenge the idea of purely abstract categories from which to understand the many realities in the world (Chakrabarty, 2007). It requires the study of African realities to be narrated from the margins. Ngũgĩ wa Thiong'o (1986) argues that African realities have far too long been seen in terms of tribalism and affected by the great struggle between imperialist tradition on one hand, and a resistance tradition on the other. He points to the influence of 'international bourgeoisie' and multinational as well as the native ruling classes in the continent that continue to remain locked in European terrain. While acknowledging the achievements of European modernity and taking inspirations from it, Fanon (2005) long ago argued that European modernity can no longer be the model to be imitated or guide the rest of the World because of all the setbacks and sufferings inflicted on humanity and the planet. He said 'When I search for Man in the technique and the style of Europe, I see only a succession of negations of man, and avalanche of murders' (Fanon,

2005, p. 312). What Fanon (2005) was trying to argue for is the provincialization of Europe, a decentring of European thought and reason, as he declared that 'the European game has finally ended; we must find something different' (Fanon, 2005, p. 312). Instead, he asked us to stop blaming Europe, and start searching for a new model and blueprints to tackle what he referred to as the new problems, which are the 'human condition, plans for mankind, and collaboration between men in those tasks which increase the sum total of humanity' (Fanon, 2005, pp. 312–313).

Ngũgĩ wa Thiong'o (1993) sees this as a double process of moving the Centre from its assumed location in the West between nations and within nations and recasting the Centre into a 'multiplicity of spheres in all the cultures of the world'. Indeed, Ngũgĩ wa Thiong'o is concerned with decolonizing African literature and cultures, but his project is more broadly and affirmatively about decolonizing the African mind. More importantly, by arguing for relocating the Centre, Ngũgĩ wa Thiong'o also points toward the possibilities of decolonizing the future and practices of future-making (Ngũgĩ wa Thiong'o, 1993). Chakrabarty (2007) refers to this process through the notion of provincializing Europe, as a way to question 'how and in what sense European ideas that were universal were also, at one and the same time, drawn from very particular intellectual and historical traditions that could not claim any universal validity' (Chakrabarty, 2007, p. xiii). Chakrabarty (2007) recognizes that in the contemporary moment universalistic thought, albeit altered by particular histories, is now everybody's heritage and impact us all in one way or the other. He sees provincializing Europe as a process by which this European universalistic thought can be renewed from and for the margins. In this sense, the conception of Black Technoscientific Discourses of Modernity can be understood as a double task of inextricably linked processes of 'provincializing Europe' and 'deprovincializing Africa', to borrow from (Ndlovu-Gatsheni, 2018). In another word, decolonizing the future requires the provincialization of Europe.

On the other hand, it is also crucially important to note that many scholars of African modernity (Comaroff & Comaroff, 2011; Deutsch et al., 2002; Hanchard, 1999; Kahil, 2013; Mahmoud, 2015) distinguish modernity from modernization. For example, Comaroff & Comaroff (2012) argue that modernity is an orientation to being-in-the-world, and specific vision of history (progressive, innovation, justice, and so forth) while modernization is a particular vision of the future (capitalist, socialist, fascist, and so forth). They argue that the issue for people in the South is not that they lack modernity, but they are deprived of the promises of modernization. Therefore, by acknowledging the desire of the people in the South to have what they understand to be modernity, the Black Technoscientific Discourses of Modernity engages the imaginative resources of the people in the margin to create their own version of modernity and fashion their own version of the future with all its constraints and contradictions with technoscience and innovation.

Therefore, African modernity is a process that establishes similarities with something that exists while simultaneously inventing something original, entails re-genesis of new possibilities and rupture of the past (Comaroff & Comaroff, 2012; Nuttall & Mbembe, 2008). It combines the native and alien, the traditional and foreign, into something new that can extend control over the future. Comaroff & Comaroff (2012) argue that African modernity is both a 'discursive construct and empirical fact, both a singularity and plurality, both a distinctive aspiration and a complicated set of realities, ones that speak to tortuous endogenous history still actively being made' (Comaroff & Comaroff, 2012, pp. 120–121). That is to say, the margins are engaged in creative articulation of different modernities and technoscientific formations from below and into the Centre. In this sense, the Black Technoscientific Discourses of Modernity incorporates the ideas of African modernities, modernization, and provincializing Europe-deprovincializing Africa to navigate the different technoscientific controversies in development discourse and offer different civic

epistemologies and closure mechanisms to sustain the sociotechnical imaginaries of technoscience in Africa. It highlights processes of co-production in the margins and articulates different conceptions of African futures from below by incorporating Black reason and theory from the South.

In the previous sections, I showed how ideas of modernity, Black epistemologies, and technoscientific futures comprise the different aspects of the Black technoscientific discourse of modernity. In the next section, I discuss this concept in more details situating it within STS and describe its analytical characteristics which I later used to analyze the data collected for this project.

3.5. Black Technoscientific Discourses of Modernity

So far, I argued for the need to escape dominant narratives about the future in Africa that generate binary descriptions that depict the continent as lagging behind or on the rise, producing an Africa that is either on the receiving end of technological change or a victim of technological processes. These narratives are quick to either pathologize or celebrate the continent, resulting in a simplified vision of Africa that lacks the deep understanding of the social and historical processes that are taking root in the continent. However, changing the narrative on Africa requires the epistemological tools that guide the study of Africa to be reconfigured and perhaps turned inside out to refigure the meanings and nature of the future in Africa that dominant conceptualizations of modernization (evolutionary, development models or otherwise) come to assign to the continent. My entry point to think differently about the future in Africa in the current moment of technoscientific capitalism is to think through the thick and endless web of connections in the

Black technoscience discourse of modernity including the notions of Blackness, Black reason, and the possibilities of retheorizing, reinterpreting, and reimagining the World from Africa.

To move the project of theory making to the margin, it means to think from a position that does not require the other to explain things or culture from a point of Otherness or to translate to a universalist episteme. Therefore, the decolonial project is not a project about rejecting or disregarding European thought but in many ways is about 'provincializing Europe', recognizing that European thought is both indispensable and inadequate in understanding the experiences of modernity in non-Western nations, as Chakrabarty (2007) argues. At the same time, it is a project about recognizing that the shift in understanding "Western science" as universal and global science is shaped by colonial historical narratives about the world and the exclusion of histories of science and knowledge traditions across the world, as Elshakry (2010: 98) argues.

On one register, the project of theory making from the South needs to adequately engage with the evolving nature of globalization in contemporary capitalism and its impact on both the Global South and Global North. It needs to go beyond traditional thinking and understandings of the South-North divide that are limited to issues of access, capital, resources, and so forth and to account for the multiple ways that practices of globalization are unfolding in both sides of the divide. On one hand, many scholars from the South (Comaroff & Comaroff, 2012; Goldstone & Obarrio, 2017; Krotz, 2005; Mbembe, 2021) point out that one of the most prevalent historical processes unfolding in our current time since the beginning of the twenty-first century is the decentring of Euro-America on the planetary order with all of its social, economic, political, and cultural processes. On the other hand, the lines of demarcation in terms of progress, prosperity, and development between the Global South and Global North can no longer be drawn in stable

ways as conditions of inequality, alienation, and marginalization under neoliberalism intensify in both Euro-America and the rest of the World, as Comaroff & Comaroff (2011) argue.

On the other register, the project of theory making from the South needs to adequately engage with the evolving nature of race and Blackness in contemporary digital technology formations configured by practices of technoscientific capitalism and its impact on both the Global South and Global North. From this perspective, technoscientific capitalism seems to represent a special moment in the relationship between race, capitalism, science, technology, and innovation on two interlocking accounts. On one hand, the proliferation and global dissemination of digital technology under regimes of technoscientific capitalism intensify sociotechnical and socioeconomic practices of a particular kind of innovation. On the other hand, practices of innovation under technoscientific capitalism employ new practices of commodification, assetization, and capitalization. However, they also result in new exclusionary patterns that goes beyond traditional understandings of Blackness. Therefore, there is an urgent need to examine the different ways that new conceptions of Blackness are embedded and operate in contemporary technoscientific formations specifically those of digital capitalism.

This destabilization of the understandings of the Global South-North divide and new conception of Blackness in technoscientific capitalism open up new theoretical and analytical possibilities for Black technoscientific discourse of modernity. Black Technoscientific Discourses of Modernity simultaneously locates contemporary practices of technoscience and innovation within their colonial continuum situating the lack of Black perspectives in technoscience within emerging forms of imperial practices in contemporary technoscientific capitalism but also shows how people in the Global South, and particularly Africa, engage with notions of progress and multiple modernities in contemporary technoscience formations. From this perspective, Black

technoscience discourse of modernity is an attempt to avoid the traps of binary visions that only see Africa either on the receiving end of technological innovation or victim of its outcome. Instead, it attempts to illuminate an understanding of Africa that takes into account the evolving relation between race, gender, science, and technology, and the metropole and the margin under the new global conditions of technoscientific capitalism with all of its power, politics, and innovation asymmetries that still persist in formations of neocolonialism. Black Technoscientific Discourses of Modernity attempts to amplify encounters between emerging technologies and other forms of self-fashioning and make visible the different material and cultural formations in the margins where the margins seem to still have much more work to do in terms of social theory.

However, this raises several theoretical questions. For example, what are some of the ways to think about Black technoscience in the current moment of contemporary technoscientific capitalism? How should concerns around the nested structures and layering of invisibility, raciality and locality in scientific research and technological innovation be approached from a Black technoscience perspective? And how does Black technoscience engage with processes of co-production in the margins?

The notion of Black technoscience discourse of modernity is sustained by a shared social project of Black emancipation, liberation, and equality in global spaces of technoscience that all racialized Black communities epistemic and otherwise are part of its creation. This is not an attempt to universalize Black moral philosophy or African ways of knowing but an attempt to counter exclusionary practices and ideals of Western scientific communities that serve as a barrier for equal contribution by globally marginalized epistemic communities in the development of their own technoscientific futures. There is a recognition of the diversity of Black voices, ideas, visions, and politics that are part of the Black technoscience discourse of modernity. The development of

this concept is an attempt to create common vocabulary by which different ideas about progress and development in Africa can be debated. Therefore, Black technoscience discourse of modernity is a multidimensional construct that is in constant motion and shifting by the multiplicity of the contested ideas about the future in Africa. However, it is also a construct by which these ideas can be debated and settled through democratic means while recognizing the power asymmetries that are inherent in concepts such as democracy within Western polity and political thought.

3.5.1. Technoscience from Africa

In this section, I put contemporary scholarship from African studies on the understanding of Blackness, race, decoloniality, and modernity (Comaroff & Comaroff, 2011; Goldstone & Obarrio, 2017; Mbembe, 2017a, 2021; Ndlovu-Gatsheni, 2018) in conversation with STS literature (Birch, 2013; Birch & Muniesa, 2020; Coleman, 2009; Jasanoff, 2004; Jasanoff & Kim, 2015; Star & Griesemer, 1989) to develop an African perspective on technoscience that I conceptualize as Black technoscience discourse of modernity. I later use this theoretical and analytical framework in the next chapters to analyze my corpus and examine contemporary technoscience projects such as AI in Africa. This African technoscience perspective uses generative modes of critique of African studies and builds on co-production, sociotechnical imaginaries, technoscientific capitalism, decoloniality, and the notions of boundary objects and race as a technology to create a conversation between STS and contemporary African studies and open up new ways to think about the relation between race, technoscience, and capitalism in the co-production of future imaginaries of technoscience and social orders in Africa.

Black technoscience is arriving at a crucial time when many scholars from the South, and particularly Africa (Mignolo, 2011; Ndlovu-Gatsheni, 2018; Ngũgĩ wa Thiong'o, 2009; Santos,

2014; Williams et al., 2018; Wood, 2020) are arguing for the necessity of a profound epistemic reorientation to deal with the current multiple planetary crises of our time including ecological, economic, social, and political. These scholars are demanding epistemic freedom, epistemic decolonization, and epistemic justice amid growing recognition that Western ethnocentric tendency to frame the world and all its socioeconomic, political, and cultural processes from a Euro-American perspective can no longer reconcile the promise for human and political emancipation and social justice even in the West, as Mbembe (2021) argues (pp. 33–34). However, for Black technoscience is important to recognize that the epistemic line flows from the colour line, and it is simultaneously the ontological line, 'because denial of humanity automatically disqualified one from epistemic virtue' as Ndlovu-Gatsheni (2018) puts it. Ndlovu-Gatsheni (2018) argues that the epistemic line is the major problem of the twenty-first century on accounts of the sheer volume of its complexities and entanglements with histories of 'colonial genocides', 'theft of history', 'epistemicides' and 'linguicides' (p. 3). From this perspective, Black technoscience can be understood as a different STS view from below, an epistemic reorientation of modernity that offers different theoretical and analytical lens from which to examine formations of technoscientific capitalism from the vantage point of the globally marginalized epistemic communities in Africa and elsewhere in the World. In what follows, I outline four major tenets of my theoretical and analytical framework.

First, *Africa as a boundary object*. Star & Griesemer (1989) define boundary objects as 'both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites' (p. 393). They explain that boundary objects may be abstract or concrete and have different meanings in different social worlds, but their structure is common enough across multiple worlds to make them recognizable.

Many objects of scientific inquiry can be regarded as boundary objects since most scientific work involves intersectional work and boundary making (Gieryn, 1995; Star, 2010). The notion of boundary objects has been applied to many studies in areas as diverse as innovation studies (Djelassi & Decoopman, 2016), climate change (Sundberg, 2007), technological development (Fox, 2011), cultural studies (Bender, 2017), and organizational behaviour (Benn et al., 2013) to name a few. I extend the notion of boundary object to think about how Africa has been used both as an object of study and as an analytical category from an STS perspective. Africa has been used in knowledge production to provide many modern disciplines from anthropology, poststructuralism, and psychoanalysis to political economy, postcolonial, and world systems with many of their foundational categories, as Mbembe (2021) argues. On the other hand, Africa has maintained its place in formations of modern knowledge as means of translation (Callon, 1984) by which the social, political, and economic crises that long depicted the continent remain stable and recognizable between the many worlds that Africa simultaneously inhabits from development, technology, and innovation to urbanism, education, health, and so forth. However, the notion of Africa as a boundary object invites us to recognize that, as once Goldstone & Obarrio (2017) put it, 'the study of Africa can no longer be confined to its geographic borders, that the matter of where Africa begins and ends is always, necessarily, in a state of flux and cannot be settled conclusively in advance' (p. 4).

Second, *Blackness as an exclusionary archetype*. Putting contemporary African studies scholars (Mbembe, 2017b; Ndlovu-Gatsheni, 2018; Ngũgĩ wa Thiong'o, 1986) in conversation with STS scholars who conceptualize race as a technology (Benjamin, 2019b; Chun, 2009; Coleman, 2009) allows for deeper understandings of Blackness in digital technology formations of technoscientific capitalism. For example, Mbembe's (2021) view of race as a 'technology of

dispossession' (p. 53) points to what these STS scholars frame as an understanding of race that looks at race as symbolic device that structures society, not only in terms of racism, also as a set of technologies that produces a black-boxed social relations that are normalized as natural, inevitable, and automatic, unlike how other forms of domination based on ideology or history functions in society. From this perspective, if race can be understood as a tool to do things with, a technology for vision and division and a tool for exclusion (Chun, 2009), then Blackness is the archetype for such exclusionary practices. Conceptualizing race as a technology opens up other ways to think about the many forms of injustice experience of members of racialized groups by understanding how race as a technology is 'designed to separate, stratify, and sanctify, but also one that people routinely reimagine and redeploy to their own ends' (Benjamin, 2019b, p. 36).

Here, a link can be drawn to connect earlier moments of capitalism with current moments of technoscientific capitalism in the context of the creation of the "Black" subject. Earlier moments of capitalism marked the dehumanization, objectification, and commodification of the Black subject during the transatlantic slave trade. Mbembe (2017) argues that in this earlier phase, capitalism equated the Black subject with the non-human and produced the technologies necessary to submit his behaviour to measures but ultimately these measures were aimed at inscribing the Black subject within the 'circle of extraction' (Mbembe, 2017b, p. 31). The current moment of technoscientific capitalism witnesses a new development for the technology of race, another type of 'fusion between capitalism and animism' to globalize Blackness, as Mbembe (2017) contends. Mbembe (2017) argues that one of the potential implications of this fusion between capitalism and animism for our future understanding of race and racism in digital capitalism is the distinct possibility of transforming human beings into animate things made up of coded digital data where Blackness is codified and extended to the entire planet. For example, Phan & Wark (2021) argue

that large-scale data processing (e.g. big data) generates new modes of racial formations through processes of data formations using algorithmic systems. They argue that while data and algorithms can reproduce and reinforce existing racism, they have begun to transform the category of race through processes of correlations, inferences, or proxies creating a new category that they call "racial formations as data formations" that may not be traceable to what one looks like (Phan & Wark, 2021, p. 5).

In this sense, Mbembe's (2017) provocation of *becoming-black-of-the-world* points to the tendencies of technoscientific capitalism to turn everything into data that can be appropriated and extracted. For Mbembe (2017), this globalization of Blackness is underpinned by rising conditions of inequality, alienation, and marginalization under neoliberalism in both the West and the rest of the world. However, Mbembe's (2017) provocation also points to the emergence of contemporary imagination around subject formation and race conception in assemblages of digital technologies including AI. At the same time, his provocation can be seen through Coleman (2009)'s notion of race as a technology, in its simplest form as 'extending the function of techné to race'. Coleman (2009) argues that for this to happen race needs to be first alienated from its history as a biological fact with no scientific value and be understood as a technology with many qualities that includes rhetorical and material characteristics, which can be seen as constitutive practice of technoscientific capitalism from Mbembe's (2017) point of view.

Third, *globalization as a racial subsidy*. Capitalism depended on racial subsidies during its earlier moments of primitive accumulation to expand the plantation system as a commercial enterprise that spanned a great distance with the deployment of large numbers of racialized labourers, however new forms of racial subsidies continue to persist in contemporary technoscientific capitalism as well. For example, Mbembe (2021) argues that global capitalism is

moving into two directions: increasing the exploitation of large parts of the world, similar to what Marx conceptualizes as primitive accumulation (Bonefeld, 2011), and increasing the rate of technoscientific innovation. He argues that this is achieved by an active refiguring of space, resources, and time and injecting the race subsidy into the cycle of reproduction of capital. He argues that 'Euro-America depends, more than at any time in its history and nowadays in an increasingly parasitic manner, on the productive labour of others' (p. 229). Spivak (2010) also points to the critical impact of the global movement of capital and the increased international division of labour. She argues that ignoring the international division of labour renders ideology invisible and creates an economy of representations that keeps the other, non-Western, on the shadow of the Western itself, thereby allowing the universal (or global) subject to remain on Euro-American terrain (Comaroff & Comaroff, 2012). From this perspective, the margins show that capitalism has not always been able to expand to vast parts of the world without racial subsidies since the earlier moments of colonialism to the current moments of the globalization of technoscientific capitalism and the transformation of the state into a technetronic regime (Mbembe, 2017b, p. 23). Racial subsidy has become not only essential for the survival of capitalism but it is also what affords global capital the opportunity to escape the moral responsibility for the damage it inflicts not only in Euro-America but to the rest of the world and the planet, as Mbembe (2021) argues (pp. 32–33).

On the other hand, this raises other questions regarding the relation between capitalism and new forms of colonialism in contemporary digital formations such as those of data colonialism (Couldry & Mejias, 2019b) as one of these colonial modalities in contemporary technoscientific formations. The notion of data colonization problematizes data practices and the relation between race and digital technology in emerging forms of imperial practices in assemblages of digital

technologies. In this sense, data colonialism speaks to the naturalization of data collections from humans as a form of capitalist vision that sees data processing as a "naturally occurring" form of social knowledge underpinned by "commercially motivated" form of extraction that advances particular economic and governance interests (Couldry & Mejias, 2019a). Furthermore, looking at data colonialism from Black technoscience perspective shows how Blackness in digital capitalism can be understood, exchanged, valued, and allocated as a function of the market, in a world that is increasingly marked by tendencies of technoscientific capitalism to commodify and assetize everything from human life forms to human culture and experience (Birch & Muniesa, 2020; Zuboff, 2019).

In another word, the understanding of the globalization of technoscientific innovation through the lens of racial subsidy opens up different theoretical orientation for STS engagement with the Global South around issues related to technoscientific capitalism including the domination and diffusion of technological innovation. This theoretical reorientation offers different view into how technoscientific capitalism is intensifying practices of technoscientific innovation in ways that not only embed and reinforce racial prejudice, but also use race simultaneously as a technology of dispossession (Mbembe, 2021) and deriver of social and economic value (Leong, 2013; Robinson, 2000) in the political economies of technoscientific innovation.

Fourth, *decolonization as a sociotechnical imaginary*. People in Africa are deploying their own imaginative resources in conjunction with the political materialities of the same digital technologies they are confronting, attempting to counter conditions of 'radical uncertainty and social volatility', characteristic of both colonial and postcolonial forms of life in the margins, by co-producing imagined futures with technoscience and innovation that have the capacity to go beyond the duality of subjugation and liberation and offer a sense of stability and continuity

(Mbembe, 2021, p. 28). Both Appadurai (2013) and Mbembe (2021) frame the realities of social volatility in the margins as a condition of temporariness. Mbembe (2021) defines temporariness as the very regular occurrence and encounter with what we cannot yet determine because it has not yet to come or will never be definite (Mbembe, 2021, p. 29). He conceptualizes temporariness in Africa beyond simply rapid changes and volatility in life to encompass two dimensions. One is the absence of satisfactory narrative, documentation, archiving and empirical description of human struggle and achievements in the margins. The other is the fact that uncertainty, turbulence, instability, unpredictability, and chronic multidirectional shifts are the social and cultural form characteristics of daily experience in the margins. On the other hand, Appadurai (2013) argues that for people in the margins, temporariness is a daily occurrence where many things in life including physical, spatial, social, political, and moral relations have a temporary quality, therefore, the creativity of people on the margins is devoted to producing a sense of permanence. For both Appadurai (2013) and Mbembe (2021), temporariness cannot be delinked from questions and histories of race, capitalism and rendering of human-life and body as commodity and making people superfluous as capitalism is interested in the resources and not the people. Mbembe (2021) argues that one of the most brutal effects of neoliberalism has been the generalization and radicalization of the condition of temporariness, characterized by rising inequalities and social volatilities at a global stage. At the same time, the condition of temporariness is generating social and cultural forms taken by experiences on both the margins and metropole that attempt to push back against the devastating effects of capitalism.

From this perspective, projects such as decolonizing technoscience and other forms of self-fashioning such as African modernity might be understood as counter projects to condition of temporariness. In another word, to see through the analytical lens of Black Technoscientific

Discourses of Modernity is to try to understand the condition of temporariness in formations of technoscientific capitalism. Therefore, the very essence of the question concerning Black technoscience is the issue of temporariness. The task of the time for Black technoscience is to produce a sense of permanence for all of those affected by the globalization of Blackness underpinned by the condition of temporariness. In this sense, decolonizing technoscience can be looked at as a form of co-production of the different imagined futures with technoscience and innovation from the margins. The Black technoscience discourse of modernity offers an articulation of these future visions, a deeper understanding of processes of co-production in the margins with technoscience and innovation but more importantly it also highlights how these sociotechnical imaginaries are enacted and mobilized in African societies and politics. Conceptualizing, decolonizing technoscience as a sociotechnical imaginary provides STS a theoretical grounding with affordances to engage with resistance projects against digital capitalism in both the margins and metropole through generative modes of future-making aimed at countering the condition of temporariness.

3.6. Conclusion

In this chapter, I argued for an epistemic reorientation and different theoretical approach that rests on destabilizing categories of race, Blackness, Global South-Global North, science, technology, and innovation among others. I showed how this approach rests on critiques of knowledge production practices under regimes of technoscientific capitalism. I suggested that the generatively of the Black Technoscientific Discourses of Modernity encompasses STS co-productionist approaches to illustrate how both the imaginative and technoscientific resources of people in the margins are creating different encounters with the condition of temporariness and

forming different epistemic and normative understandings of the future in Africa with technoscience and innovation. On the other hand, contemporary Black and African studies scholarship shows that the term Black has never been stable (Browne, 2015; Comaroff & Comaroff, 2012; Mbembe, 2017b). On one hand, it represents the duality of Black and race and on the other, it represents a new mode of exclusion that is now being extended to the entire planet. The concept of Blackness brings both the limitlessness of vision found in objects that are not optically obtainable, as well as, the limitation imposed on the Other (Browne, 2015, p. 9). From this perspective, Black Technoscientific Discourses of Modernity can articulate the different ways new conceptions of Blackness are the precondition for the fabrication of some of contemporary technoscience innovations.

I argue that technoscience needs to actively incorporate race and look at race epistemologies to create particular technoscience that is more suited to non-Western societies including those of the globally marginalized epistemic communities. What at stake here is the opportunity to engage simultaneously with the tendency of technoscientific capitalism to universalize Blackness as a precondition that gives way to emergent forms of new imperial practices while foregrounding alternative narratives of what comes to be understood as modernity from its undersides as opposed to its centres of power and affluence.

In the next chapters, I use this theoretical view to examine the sociotechnical practices of AI in Kenya, Ghana, and Nigeria and look at how discourse shapes and is shaped by these practices in a couple of areas: AI for Development and AI in commercial settings in a regional innovation hub. I investigate the underlying visions, assumptions, and values underpinning the uptake or resistance of AI development and examine how AI development is understood by different actors including scientists, practitioners, and the state and what it means to do AI from the margins. The

main question is how AI governance should be approached in the continent. While discourse doesn't necessarily determine policy outcomes, however, it provides the imaginative repertoire from which policy draws on and greatly influence its outcome (Jasanoff & Kim, 2009). Additionally, discourse has material consequences (Suchman, 2006) and different manifestations in theory and praxis. My goal is to incorporate the generative capacity of the Black Technoscientific Discourses of Modernity to theorize technoscience in Africa from the South. In the next methods chapter, I present these research questions in more details.

4. Methods: AI Development Through the Lens of African Discourses

4.1. Introduction

In the previous theoretical chapter, I delineated the conceptual framework of my dissertation, and suggested that there are distinct discourses of modernity emerging out of contemporary African technoscience that are useful for explaining the sociotechnical practices of technoscience innovation in Africa around AI technology. As such, this project examines the different technoscientific discourses of AI in the continent as articulated by researchers, practitioners, and policymakers and looks at how these discourses shape and are shaped by AI development to understand how AI is (re)configuring the debates about development, modernization, prosperity, progress, and modernity in the continent.

The main issue at stake for this project is that the lack of African perspectives in the development of AI technology exacerbates issues of diversity, equity, and inclusion in the scientific research, circulation, and adoption of AI in the continent. This leads to negative impacts on technological innovation and advancements in AI and limits the fair distribution of the benefits of AI technology across nations, countries, and communities, while at the same time excludes globally marginalized epistemic communities from AI innovation prerequisites. From this perspective, this project aims at illuminating the different visions, ideas, and political imaginations of the future in Africa as articulated through AI development by the different AI communities and show how these imaginations shape and are shaped by the development of AI technology in the continent.

In this project, I conducted two empirical case studies about AI development in the continent. In the first case, I followed the AI for Development Africa[2] (AI4D) program funded by the International Development and Research Centre (IDRC). IDRC [3] is a Canadian federal Crown corporation that funds international research and innovation, and part of Canada's foreign affairs and international development efforts. The AI4D Africa program has three pillars: AI capacity building, AI innovation, and AI Policy and is deployed across several African countries. The AI4D Africa case study is focused on Kenya and Ghana. This case was selected because it represents the largest and most established AI for development effort funded by Western international development agencies in Africa. In the second case, I examined AI development in Nigeria's AfriLabs tech hub. AfriLabs[4] is one of the largest innovation networks in Africa and has more than three hundred hubs across fifty-one African countries. I followed five AI start-ups in AfriLabs in Nigeria working in AgriTech, Transportation, Insurance, Education, and FinTech. The AfriLabs case was selected because it represents the largest footprint of innovation hubs in Africa, originated and headquartered in Nigeria. Nigeria appears to have the largest AI commercial tech activities among Low- and Middle-Income Countries (LMIC) in the continent.

I collected my data through qualitative semi-structured interviews, participant observations, and documents and employed discourse analysis to examine my corpus. In the following sections, I discuss in more details my methodological approach. I begin by outlining the research questions of this study and providing details on the selection of the case studies. I then provide details of my data collection and analytical and interpretive approach for data analysis of

2 https://africa.ai4d.ai/

3 https://www.idrc.ca/

4 https://afrilabs.com/

my corpus. Finally, I reflect on my positionality as a researcher in the field and the challenges that I encountered during my field work while elaborating on what this means for methodological approaches for future research and field work. While this chapter is presented in a linear manner, however, in practice, it is the result of an iterative approach characteristic of social inquiry and qualitative research. By this, I don't mean an approach that is only reduced to a repetitive and recursive process but more as a reflexive process that is meant to generate insight, meaning, and theory (Srivastava & Hopwood, 2009).

4.2. Research Questions

As discussed in the previous chapters, this dissertation project aims at unpacking the entanglement of AI technological development with global technoscientific capitalism and its impact on the dissemination of AI innovation practices and policy in Africa. Therefore, in this dissertation, I address the following three research questions:

1. *How is AI development reconfiguring the debate about development, progress, and modernization in Africa?*

   To answer this question, I examine contemporary discourses of AI that are emerging from the continent as articulated through interview data and different development reports, policy and strategy documents by different actors including researchers, practitioners, and institutions. My aim is to understand how these different social actors in the selected African countries (Kenya, Ghana, and Nigeria) engage with AI and to what sociotechnical imaginaries their understandings of the risks and benefits of AI are articulated in these countries while examining their visions, discourses, assumptions, and values underpinning AI development

and influencing AI policy proposals and ideas. I also look at how much of AI development is shaped by the colonial legacy in Africa. I argue that while there are different understandings of what decolonization means in the African context by different social actors, nevertheless, decolonization has become salient in the so-called *responsible AI* discourse as such decolonizing AI can be understood as a sociotechnical imaginary of the future in the continent.

2. *How is the AI innovation ecosystem configured in Africa and what are the implications for local sociotechnical practices of AI innovation?*

   In answering this question, I interrogate AI sociotechnical practices related to the AI4D Africa program and AfriLabs tech hub and examine the different ways AI manifests itself within the scientific research and innovation ecosystem. In analyzing these cases, my goal is to understand what it means to do AI from the margins, how different actors shape the development and commercialization of AI, how AI development is funded and supported, what influence Western social actors such as IDRC and transnational corporations have on the scientific research dissemination and adoption of AI, and how much agency local actors such as ACTS, and others have over AI initiatives. I argue that despite the current shift in international development discourse towards *development ownership*, a new approach that attempts to give more agency to local actors and sovereign states in influencing the development agendas, resources, and outcomes (Harper-Shipman, 2019; Overton, 2019), globally marginalized epistemic communities including those of AI in Africa continue to be excluded from the AI innovation creation process in both its sociotechnical imaginaries and political economies of innovation.

3. *What are the AI governance issues in Africa and how should AI governance be approached in the continent?*

   While the other two research questions are descriptive in nature, this one has a normative aim to it. Expanding on the notion of decolonizing AI as a sociotechnical imaginary, I explore the emergence of a pan-African imaginary of AI. I argue that one way that helps us refine our understanding of technoscience in Africa is to look at AI development as a state-building experiment in post-colonial Africa. I contend that this as a more fruitful approach to AI governance and innovation policy that challenges universalist views of technoscience and innovation. To build this argument, I examine the social, political, and economic issues implicated in the development of AI based on the cases of AI for development and commercialization. My aim is to look at how social actors approach the issues of the development of responsible, ethical, transparent, fair, and sustainable use of AI technology in a way that can inform situated approaches to technoscience governance in the continent.

4.3. The Case Studies

My methodological approach is based on two case studies that examine AI innovation sociotechnical practices within the context of scientific research and development funded by international deveplopment program as well as in industry settings. Mitchell (2009) defines case study as 'the fundamental descriptive material an observer has assembled by whatever means available about some particular phenomenon or set of events' where the case material is simply the raw content collected by the observer prior to any analysis (p. 168).

From this perspective, a case can be understood as a bounded system of interest that can be a wide range of possibilities including an institution, programme, responsibility, collection, or

population, and so forth (Schwandt & Gates, 2018; Stake, 2009). However, Mitchell (2009) emphasizes that the difference between case study and other approaches of assembling systematic information about social phenomena is the fact that in case study the social data is organized in a way that preserves the unitary character of the social object under study. In this sense, the distinctiveness of the case is kept by giving great prominence to what the case is and what it is not while maintaining clear boundaries and focusing on what is happening and considered important within its defined boundaries.

In this project, the case studies span multiple sites by tracing AI innovation networks and their various pathways, interlocutors, and communities as they span multiple geographies from Canada to Kenya, Ghana, and Nigeria. As such, I took multi-sited approach and was inspired and guided by multi-sited ethnographic sensibilities (Hine, 2007; Marcus, 1995, 1998; Marcus & Fischer, 1999) in the collection of the data and the examination of the case studies. I define this approach as a multi-sited ethnographic case study, a methodological approach that employs both case studies and multi-sited ethnographic sensibilities to study a particular phenomenon. Schwandt & Gates (2018) define this kind of approach as ethnographic case study, a case study that employs ethnographic methods. In this approach, it is not only the data collection techniques are what sets this approach apart from other qualitative methods but rather the sociocultural interpretation of the case (Fusch et al., 2017; Hiruy, 2014; Ó Riain, 2009).

Unlike traditional STS ethnographic approaches that are connected to singular sites such as in laboratory studies (Latour, 1983; Law, 2004; Sismondo, 2011), multi-sited ethnographic case studies have become increasingly required to develop more relevant theoretical directions and adequately engage with the multiplicity of technoscience practices and the diversity of groups

(publics, practitioners, policymakers) and institutions (scientific, business, governmental, non-governmental) that constitute contemporary technoscience practice that STS wants to influence.

My case studies in this project address two networks of actors and institutions that are playing significant roles in shaping the development of AI in Africa. While these networks appear to be separated by boundaries of practice areas (research, industry), countries (Kenya, Ghana, Nigeria), and mandates (development, commercialization) however they cross each other and overlap in many ways related to their sociotechnical and knowledge production practices, provided the limited resources and funding sources available to AI development in the continent and the current trends of the globalization and dissemination of AI innovation practices. From this perspective, multi-sited approaches to AI case studies and data collection in Africa offer the opportunity to map out meaningful connections between seemingly disparate sites, produce more adequate accounts and narratives, and make general assertions about the role of AI in the national debate about progress and prosperity and in the process of future making in the continent. I also want to emphasize that this does not mean, I overlooked the cultural and socioeconomic diversity of the continent and the distinctiveness of each African state at the national level, but rather this is treated as thread weaving throughout the examination of these two case studies.

By selecting the case studies below, I extend my inquiry to two empirical cases of AI in African in two contexts: an international development program by Western countries that is designed to empower Africans to have more inclusive and prosperous future using AI technology, and an innovation tech hub focuses on entrepreneurship and commercialization programs of AI start-ups. In the first case, the theme of the AI4D Africa program is to support the development of the responsible AI to avoid many of the discontents with AI technology, namely algorithmic biases, inequalities, discrimination, and human rights issue. Like many other international

development programs, the underlying vision of this program is to address long standing socioeconomic issues because of histories of colonialism and injustices in the continent. While the practice of using technoscience to solve international development issues is not new (James, 2010; Warschauer & Ames, 2010). However, this case is interesting in the sense that AI ethics discourse seems to take a universalist approach into addressing AI controversies and concerns including the exacerbation of social and economic inequalities, as such this program is designed with AI ethics embedded as a constitutive part of its African mandate.

On the other hand, the second case highlights the underlying tensions between the globalization and dissemination of AI innovation with all its flaws and tendencies to universalize technoscientific practices and local sociotechnical practices of AI innovation in the continent. What at stake in this case is the quest of globally marginalized AI epistemic communities in Africa for an equal voice in technoscience spaces built with legacies of colonial structures that are still persistent in contemporary societies with all of their asymmetries of wealth and power. Together these case studies highlight the role of contemporary international development programs and the potency of innovation discourses and approaches in the co-production of technoscientific practices and the political imaginations of the modern post-colonial African state. How it should be configured and constructed, and what it means to be an African technological state in a globalized world. Below, I provide more detailed background on these cases.

4.3.1. AI in Development Program (AI4D Africa)

The AI4D Africa launched in 2020 as a four-years, $20 million Canadian dollars partnership between IDRC and the Swedish International Development Cooperation Agency (Sida). The goal of the program is to support policy, innovations, and leadership in the

development of responsible AI in Africa with gender equality as an underpinning theme. The vision is to support African-led AI initiatives in both applied research and the applications of AI technology that are aimed at solving development issues and improving the livelihoods for those living in poverty. In doing so, AI4D Africa partners with Africa's science and policy communities in the development of AI by providing support for scientific research, responsible innovation, and talent development. Since its inception, the program has expanded to many countries in sub-Saharan, southern, and western Africa including Uganda, Kenya, Tanzania, South Africa, Nigeria, Ghana, Burkina Faso, Senegal, and Gambia. Each one of these nodes implements a specific aspect of the program as illustrated in figure X below. This figure is part of public documents and reports IDRC interlocutors shared with me during this research under Fair Use terms. It is also important to mention that IDRC assumes the leadership, administration, and management of this program.

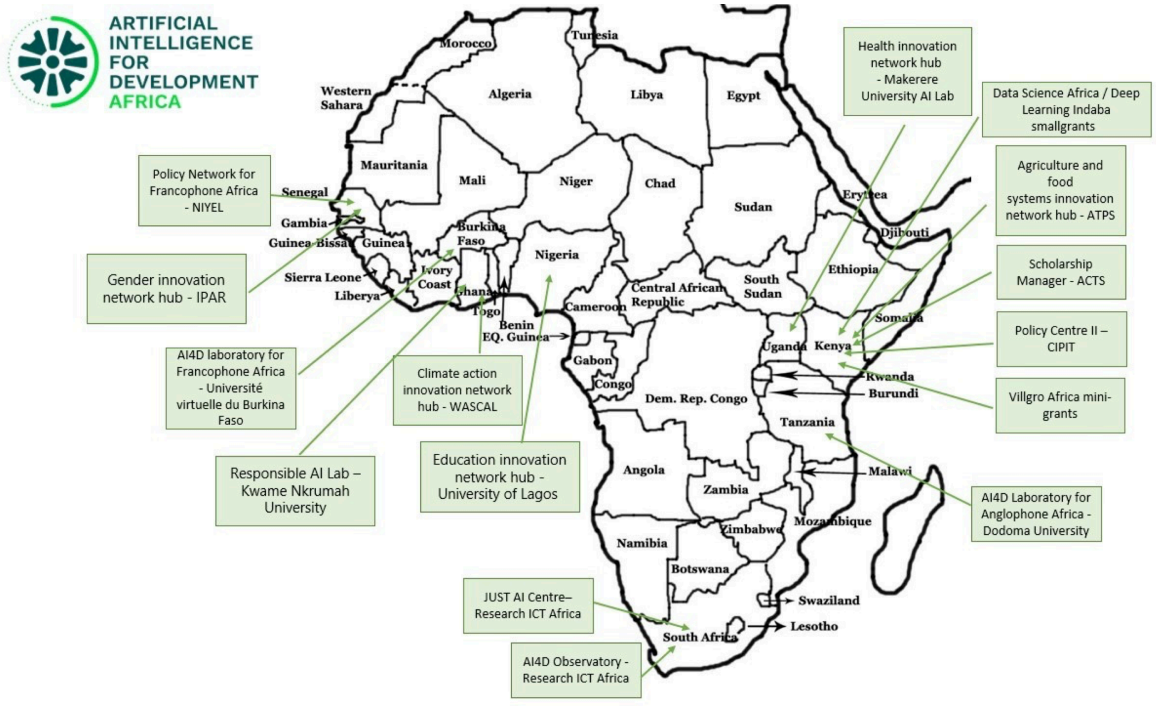

Figure 1: An overview of the geographic distribution of the AI4D Africa program (IDRC AI4D and AI4COVID Report, January 2022)

The innovation stream of the AI4D Africa program is designed to support pan-African AI4D innovation research networks each focused on specific development issue such as agricultural, health, education, and so forth. The policy stream is designed to support AI4D research "think-and-do tanks" that are distributed between Anglophone and Francophone countries and engaged in AI policy research to inform public policies and regulations related to the development of responsible AI. The capacity building stream is designed to support the creation of multidisciplinary AI4D labs in public universities and offer AI4D scholarship program to support the next generation of PhD and early career academics working on the AI4D projects across the continent.

In this case study, I interacted closely with the African Center for Technology Studies (ACTS) [5] in Kenya and the Responsible AI Lab (RAIL)[6] in Kwame Nkrumah University of Science and Technology (KNUST) in Ghana. ACTS is the main African administrator of the AI4D Africa program. ACTS is an intergovernmental organization that pursues policy-oriented research focusing on strengthening the capacity of African countries and institutions for applications of science, technology, and innovation for sustainable development in Africa. ACTS also manages closely the capacity building stream and administers the scholarships and grants programs. On the other hand, RAIL started as the Responsible AI Network (RAIN)[7], a partnership between KNUST and the Technical University of Munich (TUM) to create a network of scholars working on the

5 https://www.acts-net.org/

6 https://rail.knust.edu.gh/

7 https://rail.knust.edu.gh/

responsible development and use of AI in Africa. However, this initiative has expanded to include AI4D Africa and German Agency for International Cooperation (GIZ) in the creation of RAIL.

As a background note to Canada's international development initiative in AI, it is important to mention that at the macro level view, the Canadian government has established a Pan-Canadian AI Strategy with a commitment of $125 million Canadian dollars in funding to bolster Canada's global leadership in AI research and development and increase its contributions and investments into AI governance in Canada and abroad.[8] This is important because the Pan-Canadian AI Strategy include multi-million-dollar component to fund research on AI governance in LMIC and while IDRC AI4D Africa program is funded independently, however, at the strategic level, both efforts align and coordinate with respect to Canada's international agenda on AI.

4.3.2. AI in Innovation Hub (AfriLabs)

The global trends towards the digital economy have transcended the advanced economies of the Global North to geographies of the Global South. For example, there is a growing innovation ecosystem in Africa. According to research from GSMA Ecosystem Accelerator in 2019, there are 618 active regional innovation technology hubs across Africa, representing 40% increase from 442 hubs in 2018 (Giuliani & Ajadi, 2019) and 314 hubs in 2016 (Boucher, 2016), see figure X below.

8 https://www.cifar.ca/ai/pan-canadian-artificial-intelligence-strategy

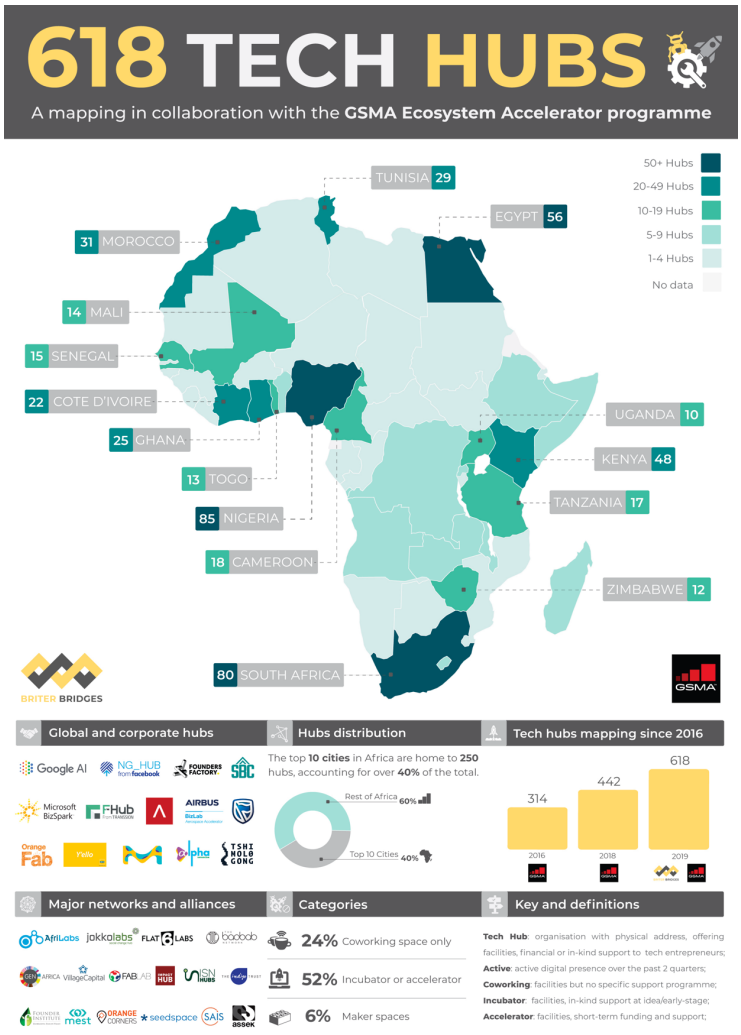

Figure 2: An overview of tech hubs distribution in Africa in 2019 by GSMA (Giuliani & Ajadi, 2019)

In this growing ecosystem in Africa, AfriLabs is one of the largest network organizations in Africa with over 300 innovation centres across 51 African countries and partnership agreements with many of big tech, regional and transnational organizations, and international development agencies including Google, Facebook, IBM, the World Bank, UK aid, and GIZ, according to AfriLabs 2021 annual report. The idea behind AfriLabs is to create a network of pan-African organizations of tech innovation hubs across multiple African countries. From this perspective,

AfriLabs functions as a consortium of tech organizations that support technology development and innovation in multiple regional innovation ecosystems in Africa. Oksanen & Hautamäki (2014) define an innovation ecosystem as 'an interactive network that breeds innovation'. In practical terms, the ecosystem includes local innovation hubs connected to global networks, technology platforms, and organizations (Oksanen & Hautamäki, 2014, p. 4). They define an innovation hub as "a region or a place with an extraordinary amount of accumulated knowledge and innovativeness" (Oksanen & Hautamäki, 2014, p. 4). However, Oksanen & Hautamäki (2014) emphasize the importance of the utilization of local knowledge and competencies while maintaining connectedness to a "global value network" and the ability to create value in the "global economy".

According to Oksanen & Hautamäki (2014), components of an ecosystem include a group of local actors, dynamic processes, entrepreneurial culture, finance providers, large established companies, start-ups, customers, top-level universities, and research institutions. Over the last decade, AfriLabs has expanded its areas of practice beyond organizing programs and events to providing entrepreneurial consultative services including capacity building, research, and policy advocacy.

In this case study, I interacted with AfriLabs in Nigeria, specifically a group of member start-ups working on different applications of AI technology including AgriTech, education, insurance, transportation, and FinTech. I participated in workshops, seminars, internal demos, and interviewed start-up founders. These start-ups are part of the AI tech incubator of the Data Scientists Network (DSN), formerly known as Data Science Nigeria, which is a member of AfriLabs. DSN focuses on building AI talent in Nigeria in multiple areas of AI practice including machine learning, natural language processing, and deep learning.

4.4. Operationalizing The Black Technoscientific Discourses of Modernity

The notion of Black Technoscientific Discourses of Modernity requires engagement with the sociotechnical imaginaries of AI in Africa. Jasanoff & Kim (2009) point out that imaginaries are articulated through a reservoir of norms, discourses, metaphors, and cultural meanings. They argue that imaginaries describe particular futures that state and non-state actors believe that are attainable through science and technology. From this perspective, this study aims at apprehending the discourses that are influencing and influenced by AI development in the continent as they are expressed through interviews data and development reports, policy, and strategy documents. Discourses and their imaginaries represent rich repertoire of ideas, visions, values, and assumptions that can provide valuable insight into the research questions of this study.

I used discourse analysis (Hajer, 2006; Phillips & Hardy, 2002; Talja, 1999) to examine informants' conceptions, ideas, and visions of how AI technology influences development in Africa and how it impacts the conceptions of the kinds of futures they envision in the continent. Discourse analysis has a wide range of definitions, approaches, and applications (Cooren, 2014; Mitra & Watts, 2002; Mullet, 2018; Pälli et al., 2009). Johnson & McLean (2020) offer an encompassing definition for discourse analysis, as a research approach that views language as a social practice that influences and is influenced by the social world. Other researchers such as Angermuller (2015), Manzi (2012), and Toews (2015) emphasize the role of linguistics and other semiotic resources in certain contexts in the construction of social realities, structures and subjectivities.

In broader theoretical terms, my approach for discourse analysis in this study adopts Hajer's (2006) definitions that views discourse as an "ensemble of ideas, concepts, and categories through which meaning is given to social and physical phenomena, and which is produced and reproduced

through an identifiable set of practices" (p. 67). In this sense, Hajer (2006) emphasizes the performative aspects of discourse. In practical terms, I follow Phillips & Hardy's (2002) process in which they outline the practical steps in discourse analysis as a process of systematic and structured studying of a set of interrelated texts and the practices of their production, dissemination, and reception with the aim of exploring the relation between discourse and social reality. These approaches (Hajer, 2006; Phillips & Hardy, 2002) are appropriate for this study because they privilege macro-orientation towards over archiving patterns of discourse articulations and how these articulations relate to the broader social context.

These approaches are also consistent with the linguistic turn in social sciences and use many analytical features that provide insights about the linguistic practices in the circulation of the different ideas and visions in the text understudy (Holmes, 2001; Toews, 2015). However, they differ from critical discourse analysis (van Leeuwen, 2006) in the sense that they do not only focus on close analysis of the linguistic characteristics of the text and its production and consumption, which may lead to detaching the analysis from the focus of this study on macro-level analysis of politics and imaginaries of technoscience and their underlying power structures. They also differ from Foucauldian notion of discourse analysis in the sense that they don not only focus on the examination of specific dominant knowledge production practice or regime but rather emphasizes conflicts and contradictions between different articulations of discourses (Johnson & McLean, 2020).

I use these approaches to examine both the interview data and documents. Specifically, Talja (1999) argues that discourse analysis has important implications when used as an analytical tool for interview data because participants construct versions of actions, cognitive processes, and the phenomena understudy through regular interpretative practices that are embedded in their

answers. She explains that in this sense discourse analysis as an analytical approach does not look at the individual as the principal unit of analysis but rather endeavour to acknowledge that participants answers are much more context dependent than it is usually recognized, therefore, it attends much more closely to the cultural regularities in participants' accounts to study the phenomena at the macro level. Discourse analysis is also useful when examining documents including policy reports, proposals, briefings produced by governments, institutions, commercial and not-for-profit organizations. For example, Fischer & Forester (1993) draw attention to the relation between power, politics, and policy formulation. They argue that linguistic representation and framing of a specific phenomenon in policy have political implications.

From this perspective, the examination of how relations of dominance are structured and reproduced in the course of the policymaking process is a crucial part of the macro-level view of analyzing policy documents. Moreover, Hajer (2006) argues that policymaking can be regarded as a discursive practice that enables a political process of continuously giving meaning to a vague and ambiguous reality by means of metaphors, story lines and the subsequent structuration of experience through various social practices. In this process actors such as policy analysts, researchers and practitioners or participants in a study not only solve but formulate problems through the use of both normative and descriptive arguments that express or resist broader relations of power and beliefs (Fischer & Forester, 1993).

In this sense, the discursive nature of the policymaking process can be viewed as a problem definition as well as an agenda-setting exercise that assigns responsibilities to political actors and institutions while continuously embedding political discourse into sociotechnical practices (Barbehön et al., 2015). From this perspective, discourse analysis reveals the different understandings of the issues associated with the development of AI technology by different

participants and allows for tracing the different values underpinning their sociotechnical practices and policy ideas and choices.

4.4.1. Research and Field Adjustments: A Vast Continent Under COVID

My methodological choices for this project were informed by theoretical and practical considerations that I encountered in the field. On one hand, a set of challenges was related to setting the boundaries of this study. AI as an object of study in the African context is difficult to define for many reasons including the nature of the fragmented AI ecosystem in the continent, the disparities in technoscience and innovation capacities between the different African countries, and the dispersed resources available to support AI development.

The majority of AI development in the continent is supported by international development programs which tend to have scattered initiatives that expand across multiple African countries and include multiple donors. This was further complicated by the fact that Africa is a vast diverse continent with wide-ranging socioeconomic conditions and cultural characteristics and nuances, not to mention the multiplicity of languages, ethnicities, and religions. Therefore, a single AI site, confined geographically or otherwise, will not have the impetus to support adequate or deeper level of examination of AI in an African context nor allow for meaningful engagement with the research questions of this study; hence the necessity for multi-sited case study approach.

However, this approach proved to be particularly useful in revealing an emergence of pan-African imaginaries of AI through the interviews and sessions that I conducted. This prompted close examination of the narratives that are attached to manifestations of AI technology in different sectors including education, research, entrepreneurship, and industry (agriculture, healthcare, financial, and so forth) across the multiple sites where my informants located in the continent.

Some of the questions that emerged out of this process probed elements of such pan-African thinking and strategies, and the required infrastructure to support it, differences and intersections in ideas and visions underpinning pan-African AI imaginaries between sites and communities, and the relation between issues such as the lack of "African context" in AI and pan-African imaginaries of AI when it comes to AI governance questions in the continent. I discuss this later in other chapters of the dissertation with more details.

On the other hand, the original plan of field work was to travel to Nairobi, Accra, and Lagos to conduct face-to-face interviews and participant observations. The COVID pandemic situation made this unattainable with restrictions of social distancing and changes in York University's guidelines and regulations of conducting human participant research during the pandemic. I had to adjust my methods and recalibrate my tools and techniques to conduct interviews and participate in events, workshops, and seminars via online videoconferencing platforms. This presented another set of methodological challenges that I had to grabble with and figure out in the field. For example, I attempted to draw inspiration from virtual ethnographic approaches (Boellstorff et al., 2012; Hine, 2000), however virtual ethnography focuses on the study of the virtual as a site of research and examines phenomena taking place in digitally mediated sites. While digital approaches of participant observation (Kaur-Gill & Dutta, 2017; Suarez, 2019) can serve as inspiration and offer some useful techniques for asking questions and conducting observations online, however, the ontological nature of the object of study in this project is different from those of virtual and digital ethnography typically engage with.

Additionally, participant observation emphasizes the importance of spending time and participating with other participants in their natural setting and observing their social interactions and cultural productions on site (Schensul & LeCompte, 2012), which is a different experience

from online videoconferencing environments. In short, the main challenge was to find ways to study a phenomenon such as AI technology in the African context that has material-semiotic manifestation in the natural world using methods that are calibrated for digitally mediated worlds. To address this challenge, I took guidance and inspiration from existing literature on conducting qualitative research online and lessons from the field in using online tools to conduct online interviews (E-interviews) and online observations (E-observations) (Archibald et al., 2019; Lo Iacono et al., 2016; Lobe et al., 2020; Salmons, 2014; Sullivan, 2013; Weller, 2017). E-interview can be defined as a synchronous or asynchronous version of the interviewing process conducted digitally or online while E-observation is a version of outsider or insider observation such as participant observation that is taken place digitally or online (Salmons, 2014).

As mentioned above, due to the pandemic situation, I had to conduct this study using an online videoconferencing tool. I used Zoom[9], a popular videoconferencing platform by Zoom Video Communications, Inc, to conduct online semi-structured interviews and participant observations. Although the research into the use of online digital technologies such as videoconferencing for data collection in qualitative research is still in its early stages (Archibald et al., 2019), however, Zoom and other online videoconferencing platforms as research tools offer a number of advantages and at the same time come with a set of disadvantages, and methodological and ethical issues for qualitative research. For example, Zoom provides the ability of real-time communication with geographically spread and distant research participants. This is in addition to the added benefits of convenience, flexibility, and considerable cost savings in travel and other related research expenses. Particularly, unlike many other platforms such as Skype as an example,

9 https://zoom.us/

Zoom has more security features such as authentication, meeting passcodes, encryption, and secure storage and backup of meeting recordings on the Cloud or locally on researcher's computer for privacy and data protection without the reliance on third-party software which minimizes security and privacy breaches.

On the other hand, online videoconferencing tools like Zoom have disadvantages including the difficulty in connecting and joining online sessions, and call quality and reliability issues resulting in session interruptions and user frustrations. In my field work, I relied on the real-time video capability during the interviews and participant observation sessions as it provided a reasonable alternative to being physically present in the room and allowed for establishing rapport with participants while replicating features of face-to-face interviews such as the transmitting and responding to verbal and non-verbal cues during interviews and events.

4.4.2. Data Collection

Data collection for this project was conducted through semi-structured qualitative interviews, field notes and recordings taken during online participant observation in events, workshops, and conferences, as well as secondary data sources including reports, and policy documents from various institutions. I recorded the interviews and online participation using Zoom, transcribed them using an AI software called Otter AI[10] which employs Natural Language Processing, and securely stored them on my personal computer, which is password-protected. Research participants were informed of the aim of the project, confidentiality policies, and ethics approval. I obtained their consent after sharing with them the Informed Consent Form approved

10 https://otter.ai/home

by York University's Office of Ethics Review Board and the Human Participants Review Sub-committee. The ethical approach for conducting this research conforms to the standards put forward by the Canadian Tri-Council Ethics Research Board.

My approach for data collection was divided into three phases. The first phase consisted of conducting literature review examining the evolution of the relation between race, technology, and capitalism. This was important first step to establish analytical lens through which this project can trace and examine digital technologies in Africa considering the colonial legacy of the continent. I had access to both York University and Harvard University online/offline libraries during this study, where I was a Fellow at the Harvard Kennedy School program on Science, Technology, and Society. I also searched the Web of Science and Google Scholar databases. I used search terms such as "technolog*" and "technoscien*" with other terms like "Black studies", "critical race studies", "critical algorithm studies", "African studies", "datafication", "AI", "innovation", "development" and "political economy of science". My aim was to understand how technoscientific practices have been examined in the context of racial analysis, how conceptions of race and Blackness evolved over time, and how the notion of race has been taken up in contemporary technoscientific formations including digital technology and AI. This was a necessary step to understand Black and African thought perspectives on technoscientific capitalism and examine the relation between race, technology, and economy from an STS perspective while integrating contemporary Black and African Studies perspectives on digital technologies including AI.

The second phase involved a review of Canada's international policy efforts on AI innovation considering the involvement of Canadian international development agencies such as IDRC as well as national digital and AI strategies across the selected African countries (Kenya,

Ghana, and Nigeria). The aim was to understand how innovation visions and discourses are informing policy strategies in the selected African countries and their impact on funding priorities and addressing socioeconomic issues in the continent. This phase included a combination of literature review and qualitative interviews. I conducted semi-structured interviews with Canadian officials and program officers connected with Canada's role in international AI initiatives. The secondary data collection during this phase consisted of a review of a wide range of scientific publications including journal articles, books, reports, and policy documents from Canada, Kenya, Ghana, and Nigeria. My aim with this phase was to understand the different manifestations of AI in Africa, AI innovation policy and sociotechnical practices, and what influence that the different Canadian actors have on the development and commercialization practices related to AI in the continent. I was also interested in understanding what role innovation diffusion from the West plays in shaping the development of AI in these African countries, and how Western conceptions of policy, innovation, and AI ethics frameworks are taken up in the continent.

The third phase was an in-depth examination of the two case studies which consisted of conducting semi-structured interviews with researchers, scientists, and policy analysts connected to the AI4D Africa program across two sites in Kenya and Ghana and practitioners and entrepreneurs in AfriLabs tech start-up hub in Nigeria. I also carried out online participant observation at several events, workshops, and seminars at these sites. My aim during this phase was to understand how the innovation ecosystem is configured and how the different social actors articulate the challenges and opportunities of AI in the continent while probing their understanding of the lack of African context in AI and examining the values and assumptions about innovation that are influencing their AI development efforts and sociotechnical practices.

4.4.2.1. Qualitative Interviews

I conducted forty semi-structured in-depth qualitative interviews (45-90 minutes) using both purposive and snowball sampling techniques to ensure a range of informants (Roulston & Choi, 2018). The purpose of the interviews was to seek deeper insights that cannot be obtained from documents and secondary sources. See table 1, table 2, and table 3 below for details on interview participation.

Table 1: Interviews by country

Country	Kenya	Ghana	Nigeria	Canada	Other
Number of Interviews	12	8	10	7	3

Table 2: Interviews by job function

Function	Practitioner	Researcher	Policy Analysts
Number of Interviews	14	15	11

Table 3: Interviews by gender

Gender	Women	Men
Number of Interviews	9	31

There was some overlap between these categories as some informants are involved in more than one functional area, where most of the overlapping areas is a mix of researcher and policy or practice and policy. Participants were divided unevenly along the gender line.

It is important to note the gender distribution of interviews given the salient issue of gender inequality in the fields of science, technology, engineering, and math (STEM) and the emphasis of international development programs, particularly the AI4D Africa, on issues of gender inequality. Every effort was made to increase the participation of non-male in the research; however, this distribution is reflective of the state of gender inequality in STEM, and particularly in Africa and within the beneficiaries of the AI4D programs and tech incubators in the continent. I address this issue in more details in chapters six and seven of this dissertation.

I grouped my interview questions into three main themes. The first one is about AI innovation from Canada to Africa, targeting Canadian informants in government and IDRC who are involved with Canada's international effort in AI development. The questions explored Canada's vision and role in AI development globally and more specifically in Africa and aimed at getting a firm understanding of IDRC practices as they relate to AI4D Africa program and its relation to the Canadian government. The second theme is about AI innovation and sociotechnical practices of AI in Africa targeting technology researchers and practitioners including scientists, innovators, and entrepreneurs in the selected African countries. The questions in this area explored scientific, technical, social, and economic practices by the different actors to innovate in AI locally, regionally, and globally. The third one is about AI research and governance in Africa targeting policy practitioners and researchers working in AI policy in the selected African countries. This set of questions was focused on scientific research, innovation, and commercialization policy and explored policy issues at the national and regional levels. All interviewees were asked the same initial questions about their impression, understanding and experience with AI technology, the opportunities/benefits and challenges/risks associated with AI in Africa. The interviews were semi-structured with questions organized into the three themes; however, the structure of the

interviews permitted tangential and open-ended responses and allowed for follow-up questions based on the specific response, experience, and expertise of the informant to naturally emerge out of the conversations.

4.4.2.2. Participant Observation

In addition, I carried out participant observation (Hiruy, 2014; Siegel, 2018; Smit & Onwuegbuzie, 2018) at multiple events, workshops, and seminars to apprehend nuances that interviews might not be able to capture. The pandemic situation necessitated the employment of online observations. However it provided the opportunity to have more extensive recordings and field notes (Tenzek, 2017). Fieldnotes recorded observations on general online sessions environment, presentations content, and interaction nuances between participants. The objective was to understand in at the practical level how AI communities organize themselves, what resources are used, who is involved, what decisions are made, by whom and to what policy aims. Table 4 below lists these events.

Table 4: List of participant observation events

Date	Event	Organization
November 29-30, 2021	Steering Science, Technology, and Innovation to Achieve Sustainable Development	ACTS
December 2, 2021	Building innovation capabilities for sustainable industrialization in Africa: Status and prospects	ACTS
March 3, 2022	Using Agriculture as a Panacea for Rural Development: Lessons from Ghana and for African Agricultural Innovation Systems	ACTS
April 29, 2022	Why Hubs and Start-ups need to be involved in the policymaking process in their ecosystem	AfriLabs
June 14, 2022	Application of Responsible AI &ML	ACTS
June 15, 2022	Demonstration of AI4D Africa Scholarship Projects	ACTS
June 21, 2022	Advancing the Responsible Adoption of Artificial Intelligence (AI) at the Local Level	RAIN/RAIL
July 4, 2022	Responsible AI Applications in Africa	RAIN/RAIL

4.4.2.3. Documents

I further employed document analysis as a means of triangulating interview data and research findings (Bowen, 2009; Hajer, 2006; Prior, 2008). Both Fischer & Forester (1993) and Hajer (2006) argue that discursive and linguistic representation of policy in documents have political implications and provide insight into the structure and reproduction of relations of dominance in the process of policymaking. The available documents consisted of a range of topics including policy briefings, proposals, articles, strategic plans, vision documents, development reports, and official documents obtained from governments and institutions sites. These documents are developed by different actors such as researchers, practitioners, and organizations including agencies of the Federal Ministry of Science and Technology in Nigeria, Ministry of Information,

Communications and Technology in Kenya, Ministry of Communications and Digitalization in Ghana, African Union (AU), United Nations (UN), think-tanks such as the Institute of Economic Affairs in Kenya and Ghana, Next Einstein Forum Africa, African Center for Economic Transformation, ACTS, RAIN/RAIL, and AfriLabs.

4.4.3. Data Analysis

For the analysis of the data, I employed several techniques and methods (Adu, 2019; Bowen, 2009; Phillips & Hardy, 2002) to interpret the qualitative interview data, field notes written and recorded from participant observations, and documents collected from multiple sources including governments and institutions. I took a reflexive iterative approach based on initial deductive analysis (Azungah, 2018) to establish general themes and organize the data (Fereday & Muir-Cochrane, 2006), followed by inductive analysis (Thomas, 2006) to encapsulate the data into brief summary groupings and establish clear links between the data, research questions and objectives, and research findings derived from the data. The deductive thematic analysis involved establishing analysis based on the literature review, theoretical framework, and interview themes and questions (Fereday & Muir-Cochrane, 2006). While the inductive coding involved the identification of codes emerging from the corpus (Azungah, 2018).

I conducted extensive literature review to develop a foundational understating of the development of AI and the related policy and regulatory issues surrounding its development. I then closely read the interview data, field notes, and selected documents as part of my discourse analysis. I first created a conceptual model of a continuum of approaches to sociotechnical practices of AI development and policy and regulatory choices of AI technology that moves between two anchors of capitalist modes of AI development and adherence to capitalist norms and

values (e.g. marketization, commoditization, growth, competition, globalization, universality, etc.) to alternative model of community-based approaches that embrace more socially-oriented and locally-situated sociotechnical practices of AI development and policy. For example, the lack of data to power AI models in Africa is articulated in two ends of the continuum where one view articulates data as a commercial asset while the other view articulate data as a shared community resource based on African indigenous knowledge and philosophies such as Ubuntu. This approach is inspired by Dredge's (2017) who argues that ideas and values that underpin the choice of policy approaches and regulatory frameworks may shift over time along a wide range of choices from one side of a continuum to the other based on local contextualized discourses. This constituted the first level of categorization applied to the corpus to enable the organization and structuring of the data into areas of contestation and debates. Table 5 below lists the themes that have been used.

Table 5: An overview of the themes used in coding the data

Code	Theme Description
T1	AI Industrial Innovation
T2	AI Governance and Policy
T3	AI Technology practices
T4	AI Social Implications
T5	AI Global Dissemination practices
T6	AI Scientific Research
T7	AI African Context
T8	Political Visions
T9	Future Imaginaries
T10	Pan-African Ideas

I then used a software called Nvivo[11] for coding and management of the data based on thematic organization and the additional codes that have emerged out of the data. To develop the codebook (Appendix X), I iterated through a process of identification, coding, and tagging of different areas of the data that reflect salient norms and values, common themes and recurring expressions, phrases, and words in the corpus. I used the deductive coding approach to perform the initial coding of the data based on the identified themes and then performed inductive coding of the data as a second step (Adu, 2019). The deductive codes are interpretative and descriptive in nature. I was guided in this process by a number of methodological choices and interpretive approaches on both policy process and discourse analysis (Barbehön et al., 2015; Fischer &

11 https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/home

Forester, 1993; Hajer, 2006, 2011). In the course of my analysis, I systematically examined the language and narratives used by the different actors and identified discursive statements that are embedded within participants' articulations in the interview data and documents highlighting future making discursive and normative statements while taking into consideration the social context in which these statements were made including political institutions, organizations, groups, relations, processes and practices of their manifestations in the discourse (Dijk, 1997, p. 32).

4.5. Reflexivity: Positionality, Field Politics, and the Struggle for Epistemic Justice

In this section, I reflect on several issues related to my fieldwork including my positionality as a researcher in the field with respect to my research participants and the nature of a research topic that is entangled with issues of social and economic injustices as a result of histories of colonialism and contemporary globalization of technoscientific innovation practices in a modern neocolonial world system. I turned to feminist standpoint theory and feminist and Black feminist thinkers (Collins, 2008; Harding, 1991; Smith, 1993) for guidance as I dealt with these issues. Feminist theory offers a useful approach for conducting research with marginalized social groups. The main tenets of feminist standpoint advocate for knowledge as socially situated, for research, particularly examining power relations, to begin with the lived experiences of the marginalized, and for an understanding that marginalized groups are socially situated in ways that give them more ability to be aware of things and ask questions than the non-marginalized.

I reflected on my own positionality, as someone who is from an African background, but, has been living in the West for more than 20 years. This is an important consideration to think about for this research, especially from feminist standpoint as I speak of Africa and the Global South from Canada. I maintain my connection to my African home country, Sudan, and remain

deeply connected to Africa and ingrained in the different ways of relating, seeing, and being in the world as an African. In another word, I still consider myself as someone with a full African consciousness. I actively participate in the political struggle for freedom, peace, and social justice in the continent through various ways ranging from political activism, organizing, and building civil society organizations to intellectual contributions through writing, publishing, and public workshops, and seminars. I am also aware of the privileged position that my dual citizenship as a Canadian affords me to navigate issues and places with relative ease compared to those living in the continent. On the other hand, I'm also an insider to the AI community and the tech industry. I'm trained as an engineer and has been practising software engineering and ran my own software company. Through these lived experiences, I come to this research project with critical perspectives developed through practice in the tech industry, my academic training as an STS scholar, and political activism.

I reflect on how much my past experiences helped me in negotiating access to certain sites, and how much they may have influenced and created biases on my part and the part of my research participants. On some occasions, research participants asked me for help and guidance in navigating professional and practical issues in the tech industry. My response has always been positive as I genuinely want to help and not just provide a gift exchange for their time and consideration for my research. At the same time, I see these encounters as something that help me gain new knowledge while not ignoring the fact that they also help me further my academic career by presenting what I learned from these encounters to the wider academic community.

Another important aspect to consider, is that this research is taking place at a time of increased and renowned interest and pressures with many calls for decolonization in the academy and society at large. I am aware of the politics of such calls and the different ways decolonization

has been mobilized by different social groups and to what ends and by what means. One can be skeptical about the call for epistemic decolonization in the West, and there are many good reasons for that. However, I also reflect on what this means for my research participants, while recognizing the inescapable and persistent colonial legacy in world system. I felt on many occasions that, what some people on the margins struggling for is in fact epistemic justice, visibility, a sense of permanence, and the agency to create their own futures. They simply do not want to be seen as victims but rather as creators of their own modernity, which inspired some of the ideas in this project. From that perspective, while maintaining my critical lens as a social scientist, who comes with his own biases and preconceived notions of the world, I see myself as collaborating with them to show alternative ways out of the current crisis of our time and planet.

Additionally, I must acknowledge the politics of conducting field work in sites funded by international development and the so-called *social innovation* initiatives by transnational corporations. Existing power asymmetries between donors, recipients, and beneficiaries of these funding programs complicate the field and increase the challenges of navigating this kind of research. In these situations, I am always reminded of ideas of epistemic charity and guided by feminist notions of politics of care (de la Bellacasa, 2011; Martin et al., 2015).

One last note on Zoom before I conclude, my experience using Zoom as a research tool was satisfactory for the most part and had no negative impact on the quality of my data collection as pertaining to the ability to answer the research questions of this project, other than the obvious lack of physical presence which I compensated for via extensive use of the video capability in Zoom. However, I had situations where poor and unreliable electricity or Internet connectivity was a major obstacle for conducting the interviews and had to reschedule interviews a few times or interrupt the interview halfway through and resume at a later time. This has made me reflect on

the concept of infrastructure (Star, 2016) and its impact on marginalized communities in Africa. During my field work, online research made more visible the materialities of infrastructure and the social dimensions of infrastructuring in Africa.

4.6. Conclusion

In this chapter, I highlighted the methodological challenges arose during this research. I discussed how Zoom was an effective tool for conducting online qualitative research including interviews and participant observation. I also discussed how discourse analysis is a suitable analytical approach to examining Black technoscientific discourses of modernity. My research questions grabble with issues of situated knowledge production practices in AI in a global neocolonial modern world system. However, what they are trying to achieve is to engage with the political imaginations of the different AI communities about their visions of the future in Africa and how AI technology impacts these visions and in return how these visions shape the development of AI technology in the continent.

I outlined my cases studies and discussed the necessity of a multi-sited approach due to the fragmentation of the AI ecosystem in Africa. I also outlined my procedural approaches for collection, coding, and analysis of the data. My data collection was organized into three stages consisted of initial literature review, initial interviews conducted in Canada, and in-depth interviews and participant observation carried out online at the research sites. Finally, I offered some reflections on my experience in the field and discussed how approaches based on feminist theory helped me in balancing my positionality with respect to participants and the research topic and guided me through navigating and addressing the politics of the field. In the next chapters, I focus on the empirical cases and address the research questions.

5. What does it mean to decolonize AI?

5.1. Introduction

In the literature review chapter, I discussed relevant contributions from science and technology studies (STS) and cognate fields in three main areas related to this dissertation. These areas include the politics of technoscience, the political economy of technoscience, and the relation between race and technoscience knowledge production. I argued that discussions of decoloniality need be geographically situated. In this chapter, I advance this argument further by looking at emerging discourses of decolonizing AI in Africa. I examine how ideas and conceptions about decolonization shape and are shaped by the development of AI in Africa. I look through the lens of decolonization in the continent to answer the research question of *how is AI development reconfiguring the debate about development, progress, and modernization in Africa?*

In this chapter, I destabilize the way the notion of decolonization has been mobilized in AI by different social actors in the continent. I argue that discourses of decolonizing AI in Africa can be described by a particular kind of "decolonial ambivalence". I contend that this ambivalence is influenced by the persistent tension between Euro-American modernity and alternative forms of modernity in the margins. Enwezor (2010) argued that there is a dual narrative that is characteristic of modernity. According to Enwezor (2010), this duality constitutes two ideas. The first one is the unique Europeanness of modernity. The second is the translatability of modernity into non-Euro-American contexts. In another way, this tension is inherent in the idea of the mutability of modernity which results in what Enwezor (2010) dubbed as grand and petit modernity. From the perspective of Black technoscientific discourses of modernity, this idea of petit modernity in the peripheries may refer to Afro-modernity (Hanchard, 1999), Afrofuturism (Bennett, 2016), African Futurism (Bryce, 2019), and so forth. These forms of modernities represent particular articulations

of co-production (Jasanoff, 2004) in the margin. Consequently, I argue that in the case of AI in Africa, one way of resolving this tension between the metropole and peripheral conceptions of modernities is to look at decolonizing AI as a sociotechnical imaginary.

I turn to Pan-Africanism and the neglected history of African socialism as two important angles from which to look at conceptions of decolonization in the continent. To make my arguments, I used multiple sources of empirical data (interviews and documents) and organized the discussion in three parts. The first part of the discussion deals with the evolution of Pan-Africanism as an intellectual and political movement and its contribution to decolonial thinking in technoscience in the continent. For this part, I rely on discourses of Pan-Africanism as articulated in speeches and writings of Pan-African thinkers and political leaders. This is important to set the background scene for this chapter and subsequent chapters. The second part examines emerging discourses of decolonizing AI in the continent. For this part, I rely on interviews to illustrate the decolonization ideas and visions of my interlocutors. I don't present their narratives to assess them against decolonial and postcolonial frameworks, but rather to illustrate the tensions in the different conceptions of modernity. Third, I bring these two parts together to problematize the ideas of universal AI ethics and the globalization tendencies of AI innovation governance.

With respect to this dissertation, this first empirical chapter sets the field for the notion of decolonizing AI as an idea open for contestation and mutual stabilizing/destabilizing by different social actors. This process is grounded on political visions of technoscientific futures and social orders that are rooted in lived experiences of those in the margins.

5.2. A Travelling Imaginary of Africa: Pan-Africanism and Decolonization

In this section, I first look at the roots of African decolonization in Pan-African thinking that influenced decolonization efforts in post-independence Africa. Pan-Africanism has always maintained a strong connection to the anti-colonial struggle in the continent and the diaspora, historically and contemporary. Second, I look at the historical trajectory of the Organization of African Unity (OAU), the predecessor of the African Union (AU), as the de facto organization that represented at the time decolonization ideas and practices in post-independence Africa. I examine the emergence of African socialism and its contribution to decolonial imaginations in Africa including those of technoscience. African socialism represents one of the early significant contributions of Pan-African thinkers to classical Marxism by reshaping it to reflect decolonization and postcolonial ideas and struggles (S. M. Hassan, 2018). From the Black technoscientific discourses of modernity, African socialism can be looked at as one of the early incarnations of African political and technoscientific decolonization in modernity. The debates and issues that occupied Pan-African thinkers and political leaders represent the emergence of modern Pan-African ideas and conceptions of technoscience in the context of decolonization in the continent.

5.2.1. Early Discourses of Pan-Africanism in Modernity

The evolution of Pan-African thinking and political ideologies shows that Pan-Africanism, as an imaginary occupied a considerable part of the consciousness of Africans around the world. It took different forms based on the major events and political debates of the time. I argue that Pan-Africanism has always been an idea in constant motion and contestation between different African communities in different parts of the world. It was never and cannot be concretely settled in advance.

Pan-Africanism has a long historical trajectory in the consciousness of African people in Africa and diaspora. It was a worldwide movement impacted Africans everywhere they lived in large numbers whether in the Caribbean, Americas, or Africa. Pan-Africanism is often thought of as a movement started by the African diaspora, where in fact it had many forms and was conceived differently in different places depending on the political climate where Africans lived (Eze, 2013). However, the emergence of the modern African diaspora was central to the development and evolution of Pan-African thinking and political ideologies (Adi, 2018). Many diasporic figures such as W. E. B. Du Bois (1868-1963), Marcus Garvey (1887-1940) and Malcolm X (1925-1965) among others were instrumental in the development of Pan-Africanism. The early incarnations of Pan-Africanism are dated back to the nineteenth century, if not earlier. There were some notable gatherings such as the Pan-African Congress meeting in Atlanta in 1895 which focused on connecting the diaspora to Africa (Clarke, 1988; Esedebe, 1970). It was then followed by two other significant meetings in London in 1900, and Paris in 1919. However, it was not until the fifth Pan-African Congress held in Manchester in 1945 that Pan-Africanism started to take shape as a practical political liberation program for Africa, according to Adi (2018).

Historically, there have been debates and controversies among Pan-Africanists about the approaches to achieve the restoration and preservation of African culture and norms and the path towards the transformation of the future of African people. For example, Garvey and Du Bois disagreed over the future of Blacks outside Africa (Ani & Ojakorotu, 2017). Du Bois advocated for Blacks to establish their rights in “exile” while Garvey insisted that their future can only be possible in their return to Africa, according to Ani & Ojakorotu (2017). Additionally, many flavours of Pan-Africanism have emerged at different geographies and historical junctures. While

earlier forms of Pan-Africanism in the US advocated for the return of people from African descent to the continent, this was not the case in South America and the Caribbean (Esedebe, 1970).

On the other hand, Clarke (1988) points out that earlier forms of Pan-Africanism in Africa were expressed through armed resistance against slavery and colonialism. However, in many other parts of the diaspora, Pan-Africanism was more of an intellectual movement. He argues that the sense of military Pan-Africanism had developed starting with the victory of the Haitian Revolution at the beginning of the nineteenth century. This military Pan-Africanism movement included African warrior nationalists who forcefully opposed colonialism culminating in the independence of African nations. At the same time, an intellectual Pan-Africanism was concurrently developing in the Caribbean, the US, and Africa. However, Adi (2018) argues that earlier of forms of Pan-Africanism emerged during the transatlantic slave trade period from the African diaspora. This movement focused on the unity of all Africans to work towards their liberation and that of Africans in the continent. He contends that the more recent form of continental Pan-Africanism emerged in the period after 1945 in the context of the anti-colonial struggle in Africa. The aims of continental Pan-Africanism were the unity, liberation, and advancement of the African nation states while recognizing the importance of the diaspora and the need for its inclusion.

Furthermore, Adi (2018) argues that "Marxist-influenced Pan-Africanism" perspectives were prevalent among Pan-African activists in the 1920s and 1930s. These perspectives were even more predominant in the convening of the Manchester Congress in 1945. They continued in the post-World-War leading into the creation of the Manifesto on Africa in the Post-World War. This manifesto was sent to the UN conference in San Francisco in April 1945. Marxist-influenced ideas had an impact on the development of radical and revolutionary Pan-Africanism thought in different parts of the Pan-African networks. Many leading Pan-African thinkers and figures maintained vital

connections with the international communist movement and its political ideology (Adi & Sherwood, 2003).

Specifically, Communist International (Comintern), established by Lenin (1870-1924) following the Russian Revolution, developed a Pan-African approach. This approach was influenced by Du Bois and Garvey writings and activities in relation to what was called then, the "Negro Question". This question refers to how the liberation of Africa and African diaspora could be realized in such a way that the agency of Africans and those of African descent play a vital role (Adi, 2018; Berland, 1999, 2000). Since the time of its founding in 1919, the Comintern openly opposed colonialism and mandated the support of every colonial liberation movement in substantial ways as a condition for its admission. For example, the International Trade Union Committee of Negro Workers (ITUCNW) was able to forge alliances between Pan-African movements in the US, the Caribbean, and workers' movement in West Africa (Adi, 2018). ITUCNW was a Pan-African Black workers' organization with members from Africa, Europe, US, Cuba, Haiti, and the Caribbean. In South Africa, the communist party and the African National Congress (ANC) created an alliance that was instrumental in the dismantling of the Apartheid regime (Adam, 1988). In the US and the Caribbean, communists and ITUCNW played leading roles in the politics and community organizing. These efforts culminated with the civil rights movements, Black empowerment in the US, and workers' movement and anti-colonial rebellions in the Caribbean (Berland, 1999, 2000).

Strong connections between socialism and Pan-Africanism were already well established before the emergence of the Comintern, according to Adi (2018). However, there are different views among scholars about the nature of the epistemological and political connections between the Comintern and the Black liberation movements and ideologies (Berland, 1999, 2000; Walsh,

2022; Weiss, 2013; Zumoff, 2012). There were controversies surrounding the relationship between leading communist Pan-African figures such as Tiemoko Garan Kouyaté (1902-1942) and George Padmore (1903-1959) and the Comintern. Nevertheless, the Comintern was instrumental in giving Pan-Africanism a practical program and a political platform. Pan-African movements and revolutionary communist movements in Africa and the diaspora collaboratively engaged in anti-colonial and anti-imperialist struggle against capitalism. The theoretical differences between Black radicals opponent of racism, colonialism and capitalism and European socialist revolutionist movements, especially around historical development and socialist revolution theory, is beyond the focus of this dissertation. However, as I show in the next section, the focus in this project is to show that Pan-African thinkers and leading figures developed their own Marxist tradition. This was a more flexible version that transcends rigid and economistic version of Marxism, connecting the leading role of the anti-colonial struggle with world revolutions (Walsh, 2022).

Throughout its history, Pan-Africanism has always been about the return to African ways of knowing and being and reclaiming Africans place in world history (Clarke, 1988, p. 28). It advocated for the shared history, struggles, aspirations, destiny, and future of Africans in Africa and the diaspora. For example, Du Bois (1903) argued that Africans in continental Africa and the other side of the Atlantic Ocean are bounded by the affirmation of their African heritage. They are concerned with the status of Africa and the efforts to improve it, and participation in the Pan-African political struggles. These are the same ideas echoed by figures such as Kwame Nkrumah (1909-1972), Muammar Gaddafi (1942-2011), Nelson Mandela (1918-2013) among other African leaders during colonialism and post-independence. These are also the same ideas that culminated in the establishment of the Organization of African Unity (OAU) in May 1963 and continued with its successor the African Union (AU) (Quist-Adade & Royal, 2016). The AU declaration includes

those of African descent who are willing to work towards the progress and advancements of the continent in the diaspora and designated the African diaspora as the "sixth region" of Africa (African Union Commission, 2015).

There is no specific definition of Pan-Africanism because it is not a single political ideological or a specific philosophical tradition. However, there are different understandings of Pan-Africanism among Africans and the diaspora. Different scholars (Adi, 2018; Ani & Ojakorotu, 2017; Clarke, 1988; Eze, 2013; Quist-Adade & Royal, 2016) have conceptualized Pan-Africanism in different ways including a socio-political and cultural phenomenon that promotes the feeling of oneness among people of the African world; an idea that represents African personality and the movement of Africans and their descendants towards a shared manifest destiny; and a protest and demand for African transformation and utopia born out of encounters between Africa and Europe (Ani & Ojakorotu, 2017). In this dissertation, I use Adi's (2018) articulation of Pan-Africanism as 'a collection of ideas, activities, organizations, and movements that resisted the exploitation and oppression of people of African heritage, opposed and rejected the ideologies of anti-African racism, and celebrated African achievement, history, and the very notion of being African' (Adi, 2018, p. 3).

The previous discussion shows that understandings of Pan-Africanism have always been in constant evolution. These ideas have produced different manifestations of Pan-Africanism at different times and places, where sometimes appear seemingly in contradiction. However, these visions were always underpinned by an imaginary (Anderson, 1983) of common struggles, shared futures, and collective actions of Africans in the continent and the diaspora. What at stake in these debates were the unity and sovereignty of Africa and Africans as the basis for liberation, freedom, progress and prosperity of Africans in Africa and the diaspora.

In the next section, I show that with the rise of socialist discourse in Africa, Pan-Africanism started to take more of a radical program of liberation, development, progress, and African sovereignty. This program coincided with the decolonization movement in the continent post-independence. I discuss how this influenced modern forms of Pan-African technoscience in Africa.

5.2.2. Modern Discourses of Pan-African Technoscience

In this section, I look at the evolution of Pan-African discourse and ideas from the perspective of the Black technoscientific discourses of modernity. Pan-Africanism can be seen as part of the *Black consciousness of Blackness* (Mbembe, 2017). Pan-African thought and ideology emerged as a response to *Western consciousness of Blackness* (Mbembe, 2017). This is a constitutive part of European Enlightenment and its ideals of the "rational" man as an embodiment of humanity and civilization. These ideas disqualified Africans of morality and justified their domination, objectification, instrumentality, and enslavement (Eze, 2013, p. 664). From this perspective, and as a discourse of Black reason (Mbembe, 2017), Pan-Africanism can be understood as a product of modernity (Eze, 2013).

On the other hand, sociotechnical imaginaries are embedded in the political culture of specific communities and institutions (Jasanoff & Kim, 2015). They are expressed through their discourses and representations. They also influence their technoscience policies and ideas. From this perspective, I examine the emergence of the OAU as an organization that embodied Pan-African visions and thinking and had a significant impact on shaping the sociotechnical imaginaries of technoscience and innovation in the continent. In this section, I examine the political culture of the OAU to reveal the different visions of building a modern African state that is well entrenched in technoscience and innovation.

With the beginning of the independence era of African states, there was a sense of urgency to shift the focus of Pan-African thinking from the earlier focus on anti-colonial struggles. The idea was to move more towards visions of technoscience and economic development of an independent and sovereign Africa. This was prominently present in the founding summit of the OAU, as expressed by Kwame Nkrumah. Nkrumah was one of the founding state heads of the OAU and the president of Ghana, the newly independent African nation at the time.

> We have been too busy nursing our separate states to understand fully the basic need of our union, rooted in common purpose, common planning and common endeavour. A union that ignores these fundamental necessities will be but a sham. (African Union, 1963)

Since its inception in May 1963, the OAU, the forerunner of the AU, proclaimed visions of industrialization and ideas of technoscience advancements. The aim was uplifting the continent and improving the living conditions of its people, as expressed through Nkrumah's socio-political thought, speeches, and writing. Nkrumah's significance does not come only from his political leadership but also as one of the leading thinkers of modern African development and Pan-Africanism globally. He was central to the organizing of the historic fifth Pan-African Congress in Manchester. He was a prominent intellectual and member of several Pan-African networks having studied in the US and Britain. His visions of Pan-Africanism and African socialism (Nkrumah, 1967) influenced Pan-African thinking in the continent and culminated in the formation of the OAU. Many of the African leaders at the time such as Guinea's Sékou Touré, Senegal's Léopold Sédar Senghor, Patrice Lumumba of Congo, Algerian leader Ahmed Ben Bella, Mali's Modibo Keïta, Kenya's Jomo Kenyatta, and Julius Nyerere of Tanzania among many others bared his vision of African unity and Pan-Africanism (Adi & Sherwood, 2003). Many of these leaders have significant contributions to Pan-Africanism. For example, Jomo Kenyatta was one of the co-

organizers of the Manchester Pan-African Congress. Léopold Sédar Senghor was a major theoretician of Négritude, a Pan-African framework of critique and literary theory developed by mainly Francophone intellectuals in the diaspora.

However, the impact of Nkrumah's vision and thinking on shaping modern Pan-Africanism in Africa cannot be underestimated. Even after his overthrow by a coup d'état in 1966 and his exile in Guinea, where he was named honorary co-president, he continued to influence the OAU visions and ideas. Until today, his ideas and visions continue to inspire the AU Pan-African thinking and strategies. For example, the most recent *African Union science, Technology, and Innovation strategy for Africa 2024 (STISA-2024)* put forward Nkrumah's vision as the foundation for its ideas and policies (African Union Commission, 2014, p. 5).

Nkrumah was successful in developing a new kind of Pan-Africanism idea inspired by the African post-independence condition and rooted in visions of technoscience as a pathway for state-building in post-colonial Africa. He expressed this vision in his speech at the foundation summit of the OAU in Addis Ababa.

> It is only by uniting our productive capacity and the resultant production that we can amass capital. And once we start, the momentum will increase. *With capital controlled by our own banks, harnessed to our own true industrial and agricultural development, we shall make our advance*. We shall accumulate machinery and establish steel works, iron foundries and factories; we shall link the various states of our continent with communications; we shall astound the world with our hydroelectric power; we shall drain marshes and swamps, clear infested areas, feed the undernourished, and rid our people of parasites and disease. It is within the possibility of science and technology to make even the Sahara bloom into a vast field with verdant vegetation for agricultural and industrial developments. We shall harness the radio, television, giant printing presses to lift our people from the dark recesses of illiteracy. (emphasis added) (African Union, 1963)

Nkrumah's speech reflects the aspirations of the newly formed Pan-African organization towards modernization and transformative social and economic development in the continent at the nexus of science and technology. His speech highlights many aspects of African sovereignty as an imperative for advancement and progress in the continent. I emphasized part of the quote to show that his technoscientific vision was underpinned by specific political vision of economic sovereignty. It's interesting that the AU only quotes the non-emphasized part of his speech in its technoscience and innovation policy documents. This might not be surprising as I show in chapter seven the shift towards a different political orientation with the new AU vision for the new millennia.

The OAU vision was influenced by the historical and socio-political settings of its founding era. These include the scramble for Africa and European colonialism, World War I and II and the emergence of new economic empire rivalries and crisis in modern industrial capitalism. In addition, that era witnessed communist revolutions in Russia, China, and Cuba, independence and liberation movements in Africa, and anti-racism and anti-apartheid in South Africa and North America. These world events influenced modern conceptions of Pan-Africanism as a movement for democracy led by the majority of classes, and a catalyst for solidarity among Africans and other oppressed social groups.

Pan-Africanism presented a different approach for economic development opposed to economic empire-building as a viable means to end the exploitation of Africans by modern capitalism (McCarthy, 2015). Nkrumah saw that the independence of African states will remain theoretical as long as their economic systems and political policies are externally influenced and controlled by a neocolonial world system. Neocolonialism is a new kind of colonialism that replaced old colonialism in the former colonies, according to Nkrumah (1965). It points to

postcolonial practices of modern capitalism of empire-building and exploitation of oppressed nations and people of the world.

The OAU pursued a socialist vision of technological development and economic policies (Kumssa & Jones, 2014). This was influenced by the political undercurrents in the continent at the time and the rise of socialism and socialist regimes in the continent such as in Tanzania, Zambia, Senegal, Egypt, Angola, Mali, Mozambique, Guinea, Libya, Ethiopia, and Ghana. Nkrumah articulated this in his paper at the Africa Seminar in Cairo in 1967.

> Socialism in Africa introduces a new social synthesis in which modern technology is reconciled with human values, in which the advanced technical society is realized without the staggering social malefactions and deep schisms of capitalist industrial society. For true economic and social development cannot be promoted without the real socialisation of productive and distributive processes. (Africa Seminar, 1967)

Nkrumah's visions for the role that technoscience plays in the development of the continent were influenced by his ideas of African socialism. These visions can be seen in some of his writings before the formation of the OAU such as *I speak of Freedom: A Statement of African Ideology* (Nkrumah, 1961). He argued for a different kind of socialism that is rooted in African ideas of communalism.

> To be sure, there is a connection between communalism and socialism. Socialism stands to communalism as capitalism stands to slavery. In socialism, the principles underlying communalism are given expression in modern circumstances. [….]. Socialism, therefore, can be, and is, the defence of the principles of communalism in a modern setting; it is a form of social organization that, guided by the principles underlying communalism, adopts procedures and measures made necessary by demographic and technological developments (Africa Seminar, 1967)

The socialist path towards modern African development and state-building has been debated between Africa's independence leaders. The majority of these leaders subscribed to some

form of African socialism that is different from classical Marxian socialism and Soviet communism (S. M. Hassan, 2018; Mboya, 1963). These African leaders such as Nkrumah and Senghor argued that while Marxism shares humanistic characters with traditional African values of communalism and egalitarianism, these African values cannot be reconciled with Marxist deterministic, materialistic and atheistic claims (Paalee, 2017). However, Nkrumah and Senghor differ in their approach to African socialism. Nkrumah believed in the complete overthrow of colonial socio-political and economic structure. On the other hand, Senghor favoured the accommodation of the 'positive contribution of colonialism such as the French educational system, science and technology to meet the African situations' (Paalee, 2017, p. 2667). As African countries ushered into the era of independence, anti-colonial Pan-Africanism became no longer a unifying and mobilizing ideology. African socialism emerged as a pragmatic approach to Pan-African economic transformation, technological development, industrialization, and modernization aspirations in post-independence Africa. For example, Tom Mboya (1930-1969) outlined a vision for economic policies based on African socialism in the Kenyan parliament in April 1965. Mboya was a leading Pan-Africanist, and Kenya's Minister for Economic Planning and Development and Minister for Commerce and Industry from 1964 until his assassination on 5 July 1969. He drew heavily on visions of technoscience development as the major driver for economic transformation. In his speech, he asserted the role of socialist Pan-Africanism that is different from Western Marxian brand of socialism.

> We have Africans who call themselves socialists - "African Socialists" - but if you scrutinise their thought processes you discover that they are so blindly steeped in foreign thought mechanics, and in their actions, they adopt standards which do great violence to the concept of African brother- hood. […..]. When I talk of "African Socialism" I refer to those proven codes of conduct in the African societies which have, over the ages, conferred dignity on our people and afforded them security regardless of their station in life. I refer to universal charity which characterized our societies and

> I refer to the African's thought processes and cosmological, ideas which regard man, not as a social means, but as an end and entity in the society. (Mboya, 1963, p. 17)

Mboya outlined a vision of Pan-African agricultural and industrial development. His vision included building a modern transport system, expansion of the education system and universities, promotion of health education, improvement in communication systems, and supporting technoscientific research and development. He envisioned wider participation and what he called "group responsibilities" from government and society including intellectuals, businessmen, journalists, co-operatives, trade unions, and so forth to take part of the industrial development under the rubric of African socialism. He envisioned the government establishing a Development Bank, offering loans to industries, organizing the flow of foreign capital, and stimulating private investment (Mboya, 1963).

African socialism remained an elastic vision of economic and technological development and never had a clear unified thesis in the continent. It was a pragmatic approach based on socialist visions adapted to imaginations of Pan-Africanism in the post-independence era in Africa. These imaginations of socialist Pan-Africanism were institutionalized through the OAU, and the various institutions of African states and influenced their development and technoscience policies at the time (Jasanoff & Kim, 2015). In the next section, I turn my focus to emerging discourses of decolonizing AI in Africa and examine how they are shaping the debates and controversies around development, progress, and modernization in Africa.

5.3. Decolonial Ambivalence: African Discourses of Transformative Adaptation

In the literature review chapter (see section 2.5), I showed that the response to the development of AI in Africa has been locked between two binary views of AI as a predicament or

panacea for Africa's socioeconomic situation. I showed that these responses are based on normative claims about the risks and benefits associated with the adoption of AI technology and its application for socioeconomic development (Hilbert, 2016; Lee et al., 2015; Luitse & Denkena, 2021). Most of this literature tends to look at the application of AI in the continent with less critical view on the agency of the local population and role of the state (Gwagwa et al., 2021; Mann & Hilbert, 2020). I argued that what at stake in most of these controversies is the lack of African perspectives in the development of AI in the continent. As a response, discourses of AI put forward the notion of decolonizing AI as a solution to deal with the issues articulated in the African context (Adams, 2021; Y. Hassan, 2022; Mohamed et al., 2020; Peña1 & Varon, 2019). The literature on decolonizing AI highlights issues of technological domination and economic exploitation (Birhane, 2020; Bjola, 2021; Truby, 2020; Wall et al., 2021). This literature is focused on the potential for AI to exacerbate problems of inequality and injustice in the continent.

In this section, I present another view on the notion of decolonization that attempts to detach the lack of African perspectives in AI from these framings within the decolonization discourse. This view is expressed by many interlocutors including AI researcher, policy analysts, and practitioners. Based on my interviews, I argue that the issue is not that these interlocutors do not understand or reject the arguments of structural injustices that the decolonization literature has forcefully argued for. However, their response stems from the desire to resist dominant conceptions of Africa that either pathologize or celebrate the continent (Goldstone & Obarrio, 2017). In doing so, I argue that these articulations of decolonization, notwithstanding some of the interlocutors prefer not to use the world colonization, are pointing towards co-productionist notions of the kinds of African futures that decolonization aims to influence.

> I don't actually like using that word because it means you're speaking from a point of something which happened which was not perceived to be positive. […] but when you look at a technology, for me, if we are going to be discussing about, you know, knowledge, and innovation and technology, and how that knowledge can be used or can be useful, not just to Africa, or those who are generating it, but to others, because Africa today may not be generating knowledge, but tomorrow, it might be the source of knowledge. […] knowledge is not confined within one particular, you know, setting, it can be coming from anywhere […] we need to look at issues of technology, including artificial intelligence from that perspective, that the knowledge can come from anywhere, sources can be different, but there can be a change of, you know, what we call the *goalposts*, things can change and that can start coming emerging from Africa. (Interviewee #12)

The view articulated by this interlocutor suggests that the issue with the decolonization discourse has three aspects. First, decolonization appears to be locking the debates on innovation in terrains of colonization. In doing so, it skews the reality of what it is happening on the ground in Africa by not adequately reflecting the innovations that are emerging in the local context. This interlocutor mentioned frugal innovation by grassroots organizations as an example. Frugal innovation in the continent is generating 'recognized' knowledge in the local context, according to this interlocutor. On one side, frugal innovation has been linked to commercial practices of multinational corporations and criticized for 'repositioning the poor from passive recipients of donations to active consumers' (McMurray et al., 2019). On the other side, conceptions and practices of frugal innovation has been picked up by local social actors and transformed to address challenges unique to the local environment in the Global South (McMurray & de Waal, 2019; Ratten, 2019). One of the emerging ideas in this area with respect to AI in Africa is the shift towards low-resource computing. One of the interlocutors who is a prominent computer scientist started a not-for-profit organization working in this area (Interviewee #7). According to this interlocutor (Interviewee #7), low-resource computing represents the kind of innovation that is influenced by the local context.

> And I think that a lot of times, because most of AI research is done in, you know, with, with by people with a lot of resources, and not thinking about the people with fewer resources or not imagined by people with fewer resources. It ends up having using methodologies that require a lot of resources by default, and that require a lot of centralization of data and stuff by default. So I think that poses a number of challenges, it poses challenges for increasing inequality, not just inside a specific country, but between countries as well. (Interviewee #7)

With the demand of AI for high computing power and resources, this is understood given the challenges of the technological infrastructure in the continent. In the view of this interlocutor (Interviewee #12), the discourse on decolonizing innovation should be forward-looking into the future. The second issue is related to the idea that the usefulness of knowledge should not be confined to a particular geography because knowledge can be adapted to fit the goals of the local context, according to this interlocutor (Interviewee #12). In another way, decolonization seems to overlook processes of adaptation by overdoing the critique of the notion of universality and legitimizing traditional Indigenous knowledge without paying adequate attention to new practices of knowledge production in the local context. The third point is related to what this interlocutor described as the issue of "readership". This interlocutor's explanation of readership points to the notion of familiarity with the technology, the local environment, and the methods to make that knowledge relevant and beneficial to the local context (Interviewee #12). This interlocutor emphasized that decolonization is readership. In fact, that is the word this interlocutor prefers to use when referring to decolonizing AI. This interlocutor added that the idea of readership should not be limited to only people from Africa or African descent.

> I simply wouldn't understand what those guys want to achieve by pursuing the perspective of decolonizing AI? Africa didn't wait for anybody in the case of mobile money. They just needed that. Look at M-Pesa. That's innovating. It's kind of indigenous to Kenya. We need to build homegrown solutions. […]. So, there is a challenge. And you're looking at solving it, there is nothing colonial in that. So, Africa

> will have to look at their own problems that need AI strategies and solutions and solve them. And without being able to build enough technological capabilities, we cannot decolonize anything. (Interviewee #05)

Additionally, this interlocutor, an AI policy researcher in Nigeria, offered some critical views related to how decolonization is mobilized in innovation. The view of this interlocutor suggests that the decolonization discourse feels at times as a political stratagem by particular social actors within both Africa and the international community. First Africa needs to build and grow its technological capabilities, and this can only be done through technology transfer, according to this interlocutor. The next step is to adapt the technology that is being transferred to the local context. This involves a process of "reverse engineering" to build something new and specific to the needs of the local environment. These are necessary stages in models of capability development as expressed by this interlocutor. It is only then, the decolonizing technology discourse becomes relevant and fruitful, according to this interlocutor. Notwithstanding the confliction in terms of where decolonization starts and where it ends, this view suggests a conception of decolonization as a technological practice. This interlocutor explained that 'the problem in Africa is that we think we can always adapt the technology without having the technological capability' (Interviewee #05). Additionally, the view of this interlocutor suggests that there is a tendency in the decolonization discourse to generalize issues of technology transfer in Africa. This tendency results in overlooking specific processes such as reverse engineering as a pathway towards decolonizing technology. According to this interlocutor, 'when you don't have that capability to even use it, you cannot reverse engineer anything' (Interviewee #5).

> I think people talk of decolonizing AI like AI itself. It's for sure if AI comes from there it is obvious it comes with its biases. […] But, of course, we felt that those biases can bring challenges because you're going to have those things programmed and so on. […] they kind of try to guide you in certain ways. And therefore, this is colonization,

> which is already there, because we talk of the Western imperialism or whatever you call it a domination for sure, this domination can be further entrenched. […] if we need to decolonize AI the only way you can do that is obviously developing your own ways. […] depending on how the approach is, to cooperate in terms of developing AI, you probably have a very different AI than that is predicated on competition, [….] The other one is more communal, […] the more individualistic ones are more likely to be to create disruptive technologies. The more communal people are more likely to create, adapt, and improve AI. […] We call it cooperative. Probably you can take these technologies and move them in a very different direction. It is kind of decolonizing and adapting them […] That's adaptive innovation, and that is what China is built on. (Interviewee #33)

This interlocutor is a policy strategist and one of the lead technologists as part of the AI4D for Africa program in Kenya. The view expressed by this articulation put forward a similar notion of adaptation as a constitutive part of the decolonization process and decolonial thinking in technology. While acknowledging issues of biases and domination in AI, there is an assertion of African communal values in this discourse when thinking about decolonization approaches of AI in the continent.

There are other interlocutors who were less critical of the decolonization discourse, however, they expressed similar understandings of decolonization to the previous views.

> I support decolonizing AI, because it gives the room, the flexibility to make or come up with solutions that suit your local environment. I think first, you're accountable to the people around you. […] So, if the people around you are not having the effect of the work you're doing, I feel your relevance is going to be short-lived. […] So, it wouldn't be as if you are down here working for people that are in the Americas or Europe. You are using things that belong to them and anything that you come up with, in a way, it feels like you're contributing to the international body, but the international body is excluding Africa. (Interviewee #32)

What is common among these discourses of AI is a focus on the notion of transformative adaptation as a pathway towards decolonization. At the same time, these interlocutors raised issues

of power and politics in technology transfer with relation to the notion of transformative adaptation.

> I know that other technologies are being adopted in Africa, so I don't see the reason why AI should be viewed as from the West, because you can localize it to work for your case, just like another technology that we use, so I feel like AI should not be viewed, like, it's a Western technology or something that someone has a reason to fear […] unless now, the people are fearing that the technology is under control of the West. But I feel like AI can be distributed. So, the control can be distributed at some point, […] maybe we even have the African centres for AI that actually giving out the AI resources to people instead of depending on the West. (Interviewee #39)

The view expressed by this interlocutor points to a conception of an African AI project with a certain level of African autonomy in a decentralized environment of AI technology. Many of the interlocutors in the interviews called for an increased and equal African participation in the development of AI technology globally. While some of these discourses seem to be concerned with issues of power, access, or representation. They attempt to recast Africa as an equal global contributor to AI. This signals a conception of an African AI project with a global outlook. The idea of an African AI project intersects with discourses of representation that dominate the field of AI (Jordanous, 2020; Martinez-Martin & Cho, 2022; Mueller, 2007; Yang et al., 2021).

> There's no way to decolonize without bringing in the Black people into the room, because the white people, just can't think about the problems that we face. […] The biggest issue with like, Black people and Africans is that we come up with some creation. But for some reason, we were never able to distribute it […] When we build stuff, it's not for you to die with it, figure out a way to share and get others to use it. (Interviewee #09)

This interlocutor started a not-for-profit organization to promote AI in the continent. One of the activities of this organization is to advice national governments in Africa on developing national AI strategies. Like many other interlocutors, the understanding of decolonization among

these interlocutors equates decolonization with the ability to develop a global African AI project while emphasizing issues of representation in the field. In the interview, this interlocutor drew a historical comparison between African communities and other empires such as the Roman, Islamic Arabic, and others. According to this interlocutor, historically, Africans did not pursue the spread of African knowledge to other parts of the world. From the point of view of this interlocutor, there is a 'lesson here to learn' in the age of globalization for Africans (Interviewee #09).

On the other hand, these alternative discourses of decolonizing AI point to the embeddedness of questions of power in issues of representation from an international perspective.

> So, if you want to talk about this, it is because we don't have an African face in the room where these things are happening. […] And you can't get there by mere just wanting to be there. You need to go in capacity. As I say you need to go in competence. People like you need to step up and be in those rooms where the conversations are happening. […] I really don't believe that there's any colonization, I just believe that Africans need to step up. We need to increase our capacity; we need to embrace the true African spirit of Ubuntu. […] And as we get into that room, we speak the heart of Africa. And it's only then we take our rightful place in the League of Nations. (Interviewee #22)

The discourse of representation in the field has a tendency towards increased preoccupation with metrics and lacks the adequate attention to questions of power and international politics in AI (Holzmeyer, 2021; Howard & Isbell, 2020; Lin et al., 2021). However, the view articulated by this interlocutor complicates this issue and points out that representation has other elements related to the capacity to make decisions and participate in meaningful and creative ways. This view also suggests that the fixation on the AI fears seems to be based on conceptions of AI as Western technology within the decolonization discourse. According to this interlocutor, the general view in decolonization is that 'somehow if the Western world is building something for you, they are building it to work against you' (Interviewee #22). From the perspective of this interlocutor, a

good starting point to deal with these issues is when 'Africans begin to build AI for Africa' (Interviewee #22). There is a tendency in most of these discourses to invoke African philosophies as a way to distinguish the global ambition of this African AI project from that of the West. In the view of this interlocutor, an African AI requires Africans to participate in the global bodies of AI governance to protect Africa's interest. These narratives highlight an international dimension in AI development with respect to transformative adaptation as expressed by these interlocutors.

> China cannot push my interest, and the US cannot push my interest, everybody is there to their own. I know the US is a superpower. They might want to love everybody. But at least I know is that when push comes to shove in the room, they will push their own agenda or their interest. (Interviewee #22)

In summary, the previous discussion shows that there are emerging approaches to decolonial thinking in AI in the continent that privilege what Cruz (2021) describes as bottom-up decolonization. Cruz (2021) argues that technology design plays a critical role in either reinforcing or subverting coloniality in all of its forms including coloniality of power, knowledge, and being (Quijano, 2000). He points out two approaches of decolonizing technology. A top-down approach that is based on revisiting and recovering histories and philosophies of technological development. The other is bottom-up approach that is based on sociotechnical practices of technological development alongside marginalized communities through a committed and careful dialogue of knowledge. The aim of this dialogue is to produce new narratives. These narratives should be able to traverse local knowledge, colonial and modern politics and economics and embrace the fact that all matters are profoundly interconnected (Irwin & White, 2019; Jensen et al., 2017).

From the Black technoscientific discourses of modernity, the discontent of these interlocutors with how decolonization has been mobilized in AI points towards the lack of dominant discourses of decolonization to engage with co-production processes in the margins. If

the project of alternative modernity can be put simply as to 'discover the current habitations of contemporary practice' (Enwezor, 2010, p. 601). Then, these alternative discourses of AI in Africa are pointing out that these practices are found in the local context within processes of transformative adaptation, whether reverse engineering, adaptive innovation, or otherwise. If decolonial scholars were to move the project of theory making to the South, an ambition of epistemological decolonization, then they need to engage more with co-production in the margins.

5.4. AI in Africa: From Instrumental Rationality to Political Imaginaries

In the previous sections, I showed that Pan-Africanism and decolonization in Africa are inextricably linked together. I discussed ideas and visions of modern Pan-African technoscience that influenced the development debate in the continent. I illustrated that these visions were based on imaginations of decolonization in post-independence Africa. Decolonization in Africa was imagined as a process of African sovereignty in all aspects of life in Africa including technoscience, culture, politics, and the economy. This process was envisioned to be rooted in African ways of knowing and being in the world. However, as I argued in the previous section, emerging discourses of AI around development, progress, and modernity in the continent can be characterized by a form of ambivalence towards decolonization in technoscience.

In this section, I argue that this decolonial ambivalence is underpinned by a disconnect between universal conceptions of AI ethics and local understandings of the AI governance issues in the continent. I first discuss how the development of ethical AI is understood by different interlocutors and their ideas about AI ethics in the continent. I then problematize the way decolonization has been mobilized in AI ethics. I argue for the need for the decolonization

discourse to engage with the political imaginations of the AI communities and their different visions about the different technoscientific futures in the continent.

The discourse on ethics has dominated the field in recent years in response to many discontents with AI including algorithmic biases and their impact on reinforcing inequality and discrimination against globally marginalized and underrepresented social groups. Dominant discourses of AI ethics turn to Western philosophy and adopt ideas based on instrumental rationality to answer the ethical questions related to AI innovation (Adams, 2021; Wood, 2020). The majority of AI ethical guidelines today are being developed by Western countries with very little attention to examining governing models that are best suited for other geographies (Jobin et al., 2019). See figure X below.

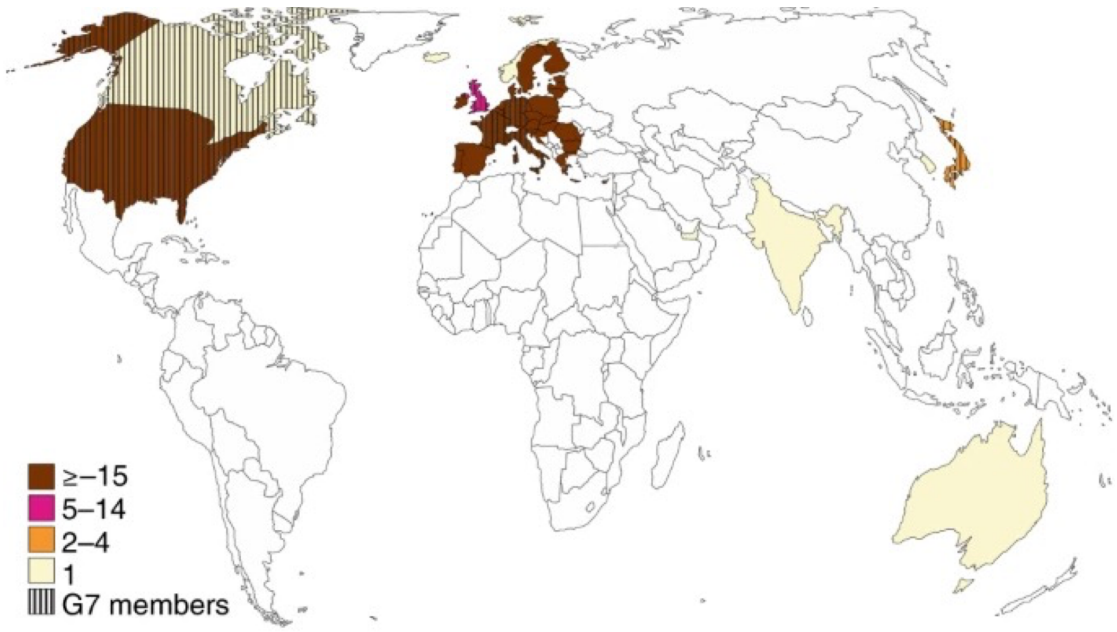

Figure 3: The global landscape of AI ethics guidelines
(Jobin et al., 2019, p. 391)

The reception of this development in AI ethics has been mixed in the continent. When talking to my interlocutors, I found different views on the perceived ethical issues in the continent.

> To be honest, I'd say that we don't really give a lot of attention to the ethical yet because, again, we're very early in […] you're focused on sort of, making beautiful products, showing that you can deliver value […] ethics depends on the nature of the products. (Interviewee #23)

One view does not put much emphasis on the ethical issues and claim to focus on the technological advancement of AI that is much needed in the continent. This view foregrounds visions of product development and approaches the understanding of the ethical issues from instrumental and technological perspectives. In my discussions with these interlocutors, they evaluate the risks of AI based on the perceived harm of their products on individuals. They also see that the ethical concerns come with the increased adoption and proliferation of AI applications which is currently perceived to be lacking in the continent.

> So, things are a bit complicated. You don't have access to data, you don't have access to fund and then most of the artificial intelligence is built on data. […] Of course, there are other challenges, but these are unforeseen, like, the ethical challenges of use of data. But so far, we have not encountered such problems. (Interviewee #40)

In many respects this view expresses similar sentiment with respect to the applicability of the current ethical debate in the global circles of AI to the continent. However, in my discussion with these interlocutors, they emphasized the lack of focus on the structural issues surrounding funding and availability of data. In the view of these interlocutors, the ethical debate should be focused on addressing the root causes of these structural challenges.

Notwithstanding, the view that AI development is still in its infancy in the continent as expressed by many interlocutors, the concerns over AI governance seem to be growing in Africa.

> I think that for now, we should follow the approach in the West, because it seems that it is new to us. […] you need to understand it first, then you can cut it to fit your size. I mean, even if you look at the responsible AI index that we are developing as part of our lab, we picked a general framework, and then out of that started working it down to suit our context so I mean, the development is by, toeing the line of the West or the line of what is happening in developed countries. But once we understand what is happening, then we could tailor the solution to fit our context. (Interviewee #35)

The general sentiment among some of the researchers and scientists is that 'you cannot devise policy or interventions for things that you really don't understand' (Interviewee #35). The view from this interlocutor at the AI lab in Ghana suggests an instrumental approach to evaluating governance approaches in the continent. This approach privileges the understanding of the technological capabilities to drive the policy ideas and proposals. As such, most of the concerns within AI ethics in Africa foreground normative and instrumental view on the ethical issues of AI in the continent (Bjola, 2021; Mann & Hilbert, 2020; Wairegi et al., 2021; Wall et al., 2021). Despite the understanding that AI governance needs to be tailored to fit the local context, most of these efforts continue to be based on Euro-American approaches (ALT Advisory, 2022; Gaffley et al., 2022; The AI Media Group South Africa, 2022).

> So, it's a blanket kind of framework and it needs a lot of work so that it makes it actually relevant to specific sectors. In the Kenyan context, you see that the Data Protection Act was actually borrowed, modelled after the UK Data Protection. (Interviewee #34)

This interlocutor, who is a policy researcher, highlights this general trend in the development of AI and data policy in the continent. As expressed in this view, the model is still to replicate AI and data regulatory approaches from other European jurisdictions because of their perceived technological advancement and adequacy. However, most African states lack data protection and privacy laws. The report from ALT Advisory shows that only 2% of African states

have dedicated AI legislative frameworks and 40% with no data protection (ALT Advisory, 2022). The figure below illustrates the progress towards data regulations by African states.

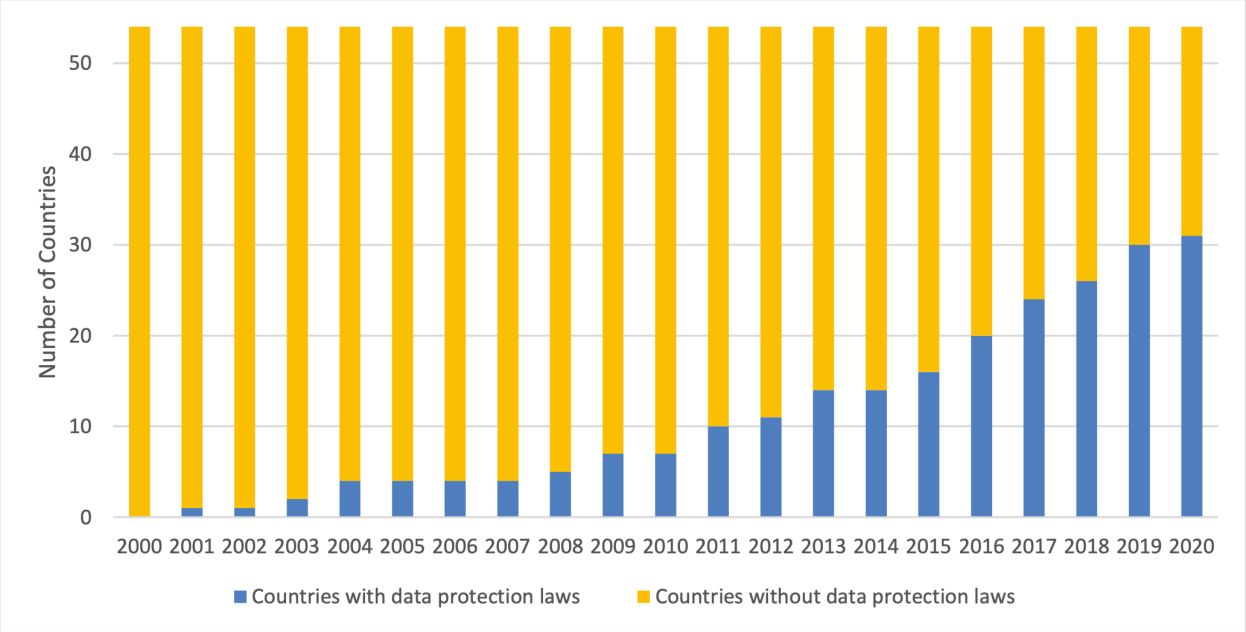

Figure 4: Data Protection Laws in Africa
(Daigle, 2021)

From this perspective, most of the AI governance debates in the continent can be understood within the global agenda on AI ethics and governance. This agenda is put forward by the international development community and supported by many nation states with significant presence in the African AI development scene such as Canada, Sweden, and Germany.

> The first is UNESCO, where we just recently finished negotiating a recommendation on the ethics of artificial intelligence where Canada was really, really taking a leadership role and where lots of African countries were very active, including Algeria, Burkina Faso, Morocco, Egypt. Like there's a few of those countries that were particularly active […] And then you know, all kinds of more traditional forums OECD, G20. Human Rights Council and increasingly, the General Assembly […] So

> it's just this multiplication of forums all over the place, and everybody wants, you know, to speak of AI craze (Interviewee #14)

As indicated by this interlocutor, from Canada's Global Affairs, these initiatives revolve around the development of digital strategies focusing on how to increase equity and create economic value for countries in the Global South, and particularly Africa. This view suggests that AI ethics initiatives are being framed around digital inclusion by the international community. The stated policy objective of these initiatives is to ensure that individuals worldwide have access to and can meaningfully and economically benefit from digital technology.

> Ethics for me, it's not really a matter of policy […] I think the biggest problem is the lack of demand from the government itself. Unfortunately, some of these projects happen because there is donor interest in doing that by financing, […] and I think unfortunately, that's what happened to most of these projects […] the government really has no incentive (Interviewee #01)

According to many of my interviews, the reality on the ground is that African governments do not exist in these discussions, at least on the local level. It appears that there are multilateral discussions at the top. However, those discussions do not involve many social actors in the local context or address the real concerns, visions, and ideas raised about the AI development community in the continent. For now, it appears that many actors in the continent are happy to engage in the global discussion of AI ethics as long as there is funding available. For them, the main concerns are to build AI solutions and products and facilitate data acquisition for their projects.

The global discussions on AI ethics and governance are biased towards Euro-American centric perspectives (Bilić, 2018; Just & Latzer, 2016; Saurwein et al., 2015; Zarsky, 2016; Ziewitz, 2016). These dominant discourses focus on algorithmic biases in AI models and forms of

discrimination in AI automated systems in the context of advanced industrialized economies. On the other hand, the emerging AI ethics approaches in Africa are less critical of the universal logic embedded in these Western frameworks (Carman & Rosman, 2021; Gwagwa et al., 2021; Kiemde & Kora, 2021; Nandutu et al., 2021). AI ethics has been criticized for universalist approaches to AI ethical issues that are grounded on Western knowledge production practices (Adams, 2021; Ananny, 2016; Hagerty & Rubinov, 2019; Mohamed et al., 2020; Peña1 & Varon, 2019; Phan et al., 2021). Furthermore, AI ethics is dominated by instrumental approaches to address algorithmic fairness and offer technological fixes for social issues (Lin et al., 2021; Peralta et al., 2021; Shrestha & Yang, 2019).

In response, decolonizing AI ethics is envisioned as a pathway to deal with many of the discontents with AI in the local context as the discourse on race and AI has become increasingly predominant in the field. As a result, there have been efforts by scholars to challenge Euro-American norms and values, and decolonize the world of AI ethics (Mohamed et al., 2020; Peña1 & Varon, 2019). While the decolonizing discourse is important and performs certain critical thinking in the field. For example, the literature on decolonization is credited for being the impetus for many of the current racial justice initiatives that are taking place inside and outside the academy.

However, with the recent rise in decolonial scholarship, many scholars critique the way the decolonization discourse is mobilized (Adams, 2021; Irwin & White, 2019; Mbembe, 2021; Moosavi, 2020; Ndlovu-Gatsheni, 2018; Ortega, 2017; Tuck & Yang, 2012; Wood, 2020). For example, Tuck & Yang (2012) argue that decolonizing has become a metaphor. On the other hand, Moosavi (2020) suggests the emergence of a decolonial bandwagon. One of the main limitations in recent decolonial scholarship is the lack of reflexivity, required for decolonization to prosper.

This is because of the hype surrounding intellectual decolonization, according to Moosavi (2020). He identified six limitations with current trends of intellectual decolonization. These include concentration of decolonial scholarly work in the Global North which can be characterized by Northerncentrism, a tendency in decolonial scholarship to ignore decolonial scholars from the Global South, as Moosavi (2020) argues. The other five common limitations include 'reducing intellectual decolonization to a simple task; essentializing and appropriating the Global South; overlooking the multifaceted nature of marginalisation in academia; nativism; and tokenism' (Moosavi, 2020, p. 332).

More specifically to AI, Adams (2021) argues that decolonial theory has been applied to only broaden the critique of AI. She argues that the decolonizing AI ethics discourse does not seem to problematize the historical origins and epistemological underpinnings of the field including ideas such as data science, ethics and intelligence.

> Well, on the aspect of colonizing AI, definitely one key aspect is the origin or, let's say the source of the data that is being used. Where it comes from? how is it collected? And how is that data being used? So, when we're talking about decolonizing AI, we need to look at this data, how is it being collected? And who is the anticipated user of that data after it has already gone through some kind of processing? So, this is now where the aspect of responsible AI comes in. (Interviewee #34)

> Of course, skill set is a big one. […] To the extent that this is one area where there will be a lot of digital divides, big divide in the sense that we have people who are using the system to create commercial solutions and others don't know what these are for, so it will end up looking like colonization. Second, colonization now is with your data. So, I feel like that's a major, major opportunity but that is a challenge for Africa to look at. (Interviewee #29).

The previous articulations by these interlocutors (Interviewee #29, Interviewee #34) represent some of the major discourses surrounding the coloniality of data and AI. Adams (2021) asks the question of whether AI can be decolonized given the way the decolonization discourse has been taken up in the field. From this perspective, Desai et al. (2022) points out that the epistemological foundations of data science focus on the theories, methods, tools, and kinds of knowledge generated by data science. They argue that the inquires of the philosophy of science into the epistemology of the field are preoccupied with issues of agnosticism and theory-free science. Inquiries into 'the genealogy of such agnostic knowledge that is generated autonomously from data' is often ignored (Desai et al., 2022, p. 18). For, Adams (2021), the important question is then what AI came to be because of histories of colonialism. She argues this is critical to avoid reproducing the same problematic that decoloniality set out to disrupt in the first place. Additionally, Wood (2020) argues that there are inconsistencies between the intention of postcolonial/decolonial theorists and their scholarly work. He argues that this is a result of their reliance on similar philosophies of difference and otherness based on the post-structuralist concept of difference (Barrett, 1987). This results in reproducing another normative and instrumental view of AI ethics by the literature on decolonization in the African context (Carman & Rosman, 2021; Gwagwa et al., 2021; Kiemde & Kora, 2021; Nandutu et al., 2021).

These scholars (Adams, 2021; Desai et al., 2022; Moosavi, 2020; Wood, 2020) raise important points about the state of decolonial scholarship in technoscience and elsewhere. I extended their views by arguing for the need for decolonial approaches to look at processes of co-production in the margin. I contend that one of the limitations of decolonial scholarship in AI is a lack of discussion of what kind of futures these ethical frameworks of AI are trying to imagine. Moreover, there is lack of attention to the performativity of their underlying political visions. The

discussions in the previous sections point towards this important aspect of decolonization with respect to the political imaginations of the AI communities in the continent.

Nevertheless, these discussions are mobilized in the field today to influence technology policy proposals and fix the broken world of AI globally. However, the literature in STS problematizes governance approaches that attempt to replicate policies across geographies and different countries (Bareis & Katzenbach, 2021; Y. Hassan, 2020; Jasanoff & Kim, 2009; Kim, 2018; Krige & Wang, 2015). These scholars argue that governance frameworks of technoscience are influenced by the imaginations of every nation about the future and how social order ought to be. In this sense, what seems to be missing from the ethical debates of AI is a more situated analysis that captures the specificities the margins demand out of such examination. As such, the appeal of decoloniality in AI as a sociotechnical imaginary comes from its emphasis on the political culture that infuses future visions of technoscientific innovation.

5.5. Conclusion

In this chapter, I showed that the debates about AI in Africa foreground decolonizing AI as a pathway towards development, progress, and modernization in the continent. I argued that there are different conceptions of decolonization by different social actors. I illustrated that historically, decolonization in Africa was understood as a transfer of power from the metropolis to former colonial possessions. It was referring to the "complete overthrow" of colonial structures, institutions, and ideas of Western modernity (Mbembe, 2021; Ndlovu-Gatsheni, 2018; Smith & Jeppesen, 2017). I examined the history of the OAU as a Pan-African organization that represented decolonial imagination of Africa post-independence. I revealed modern imaginaries of Pan-

African technoscience grounded on decolonial thinking based on prevailing ideas of African socialism.

With the globalization of AI and the dissemination of AI innovation practices in the Global South, and particularly in Africa, the topic of decolonization has become salient within the AI field given the language du jour in AI ethics. I showed that the concerns over the social impact of AI operate within universalist conceptions of ethics dominant in the AI field. I argued that current framings of AI decolonization within AI ethics reproduces the same binaries that decolonial critical thinking is trying to challenge. I also argued that decolonizing AI requires proper examination of how AI decoloniality is understood by the different institutions and actors in the AI community in Africa. I showed that some of the emerging discourses of decolonizing AI in modernity perpetuate certain understandings of co-production and foreground sociotechnical imaginaries of different contested technoscientific futures and social orders in the continent. This understanding moves the discussion on decolonization away from dichotomous ways of thinking that decoloniality is set to disrupt in the first place (Ortega, 2017; Wood, 2020). Moreover, it asserts the political dimensions of technoscience. The discussion in this chapter showed that this assertion aligns with conceptions of decolonization pursued by the protagonists of African independence. At the same time, the notion of decolonization as an imaginary must avoid recasting colonial futures and instead seeks recentring the futures of Indigenous, Black, underrepresented and marginalized social groups in the decolonizing AI discourse (Irwin & White, 2019).

6. Innovation at the Margins: Building an AI Economy for the Fourth Industrial Revolution

6.1. Introduction

In the previous chapter, I focused on decoloniality in AI. I examined how decolonial thinking is influencing AI innovation and the debate about development and progress in Africa. I argued that some of the ways in which the notion of decolonizing AI has been taken up in the continent express an apprehension of decolonization as a sociotechnical imaginary. However, as I pointed out, the understanding of sociotechnical imaginaries needs to be situated within the economic environment in which technoscientific knowledge production and technological innovation emerge.

In this chapter, I take a closer look at the political economy of AI in Africa to answer the research question of *how is the AI innovation ecosystem configured in Africa and what are the implications for local sociotechnical practices of AI innovation?* I show that the AI innovation ecosystem is configured by discourses and practices of the international development community, philanthropic foundations, and multinational corporations. The stated aims of these efforts are to build capacity for AI research and innovation in the continent. and enable the African AI community to contribute locally and globally to the development of responsible and ethical AI. These initiatives envision a development path that harnesses AI technological potentialities to tackle long-standing socioeconomic issues in the continent. In doing so, these initiatives appeal to dominant global discourses of responsible innovation (Ortt et al., 2020; Owen et al., 2013; Woot, 2017) and sustainable development (Truby, 2020; Vinuesa et al., 2019). These efforts are premised on a new orientation in developmentalism in the Global South, and particularly Africa. This orientation can be characterized by the promotion of inclusive growth and engagement with the

global economy to support sustainable development goals. These approaches focus on the pursuit of national and global objectives through close collaboration between the market and the state (Carrillo, 2014; Cornwall & Eade, 2010; Harper-Shipman, 2019).

The central argument advanced in this chapter is that the push for responsible AI in Africa is underpinned by a deficit logic that frames the lack of African context in AI as the main barrier for AI technology to address the social and economic issues in the continent. The same deficit logic also frames the lack of African perspectives in AI governance as the primary obstacle for technology transfer and diffusion in Africa (Frahm et al., 2022; Suldovsky, 2016). I argue that this deficit model (Suldovsky, 2016) influences and is influenced by imaginaries of decolonizing AI and particular technoscientific ideas of modernity in the continent (Jasanoff & Kim, 2015; Jegede & Ncube, 2021; Mbembe, 2017; Ndung'u & Signé, 2020). Although the discourses of responsible AI innovation in the continent draw on the notion of the lack of African context in AI development. At the same time, these discourses perpetuate articulations of globalization that are framed around sustainable development goals (SDGs) and the fourth industrial revolution (4IR) highlighting tensions between local and global innovation practices. I argue that these politics of deficit logic allow Western actors such as international development agencies, philanthropic foundations, and multinational corporations to influence the co-production of society and AI innovation in Africa (Frahm et al., 2022). This chapter illustrates that despite efforts by Western social actors to integrate the AI innovation ecosystem in Africa globally, the AI epistemic communities in the continent continue to be excluded from AI innovation perquisites. This impedes their ability to contribute meaningfully to dominant global spaces of AI innovation.

Table 6 below summaries the ideas presented in this chapter and illustrate the configurations of the AI innovation environment in Africa in comparison to the West.

Table 6: Comparison map of the configuration of Responsible AI Innovation

	Responsible Innovation/AI in the West	Responsible AI in Africa
Deficit Logic	▪ Public participation	▪ Lack of African context in AI (data and innovation deficits)
Objective	▪ Uptake and diffusion of technological innovation	▪ Technology transfer/reception
Stakes	▪ Economic development	▪ Global inequalities
Controversies	▪ Control, surveillance & privacy ▪ Social justice and wealth distribution	▪ Western domination ▪ Social and economic exploitation
Policy Focus	▪ R&D and commercialization ▪ Market development	▪ Capacity building ▪ Socioeconomic development and social justice (poverty reduction, industrialization/ modernization)
Funding	▪ National Government ▪ Venture/corporate investment	▪ International assistance

In the next sections, I explore this configuration presented in the map above of the AI ecosystem in the continent by looking at the AI4D Africa program and AI start-ups in a tech hub. I examine the sociotechnical discourses of AI innovation as articulated by scientists, researchers, practitioners, policymakers, and start-up founders. The aim of this chapter is not to assess their narratives and ideas against a specific preconceived development model or framework. The goal

is rather to think through their social and economic implications to reimagine an alternative development path and AI governance approach from below. This process of reimagination needs to consider the political economy of AI and innovation in the continent and its implications on local sociotechnical practices of AI.

6.2. Responsible Innovation in a Capitalist Neocolonial World System

My goal for this section is to first provide an overview of how the emerging AI innovation ecosystem in the continent is configured. In doing so, I look at two settings of AI development namely AI in development (AI4D) and AI in industry. These two areas are representative of AI technoscientific practices in the continent. I show that most of the AI development in Africa can be characterized by the efforts of the international development community and multinational corporations. These efforts are aimed at increasing AI development and innovation sociotechnical practices in the continent. I discuss the discourses, practices, and strategies of these actors to show that these initiatives are framed around responsible and ethical AI to address issues of inclusivity, equity, and equality in global AI innovation. These programs claim to focus on capacity building to reduce the gap in global AI innovation disparities between the Global North and the Global South. They target areas such as skills and talent, scientific research and development, infrastructure, commercialization of AI, and so forth. Next, I show that the discourses of responsible AI innovation in the continent are underpinned by a deficit logic that relies on the notion of the lack of African context in AI. This issue is framed as one of the main inhibitors of AI development and technology dissemination in the continent.

The insights I present in this chapter are drawn from interviews and participant observations in sessions and events that I conducted with different social actors involved with

these AI initiatives/projects at different institutions in the continent. The interlocutors that I interviewed come from different backgrounds including scientific research, policy analysis, technology implementation, and business and entrepreneurship. These interlocutors are involved with the AI4D Africa program in Kenya and Ghana, and start-ups in the AI incubator of the Data Scientists Network (DSN) (formerly Data Science Nigeria), a member of AfriLabs in Nigeria. This is a group of start-up companies working on AI applications targeting sectors such as farming, education, transportation, financial, and insurance using data science and machine learning.

6.2.1. Responsible AI as Development

In this section, I start by examining the efforts of Canada's International Development Research Centre (IDRC) in deploying the AI4D Africa program. IDRC focuses on enhancing the capabilities of low-and-middle-income countries (LMIC) for scientific research and development. According to one of the program officers, IDRC's approach is collaborative in nature, working with local actors in identifying the specific development projects to support.

> IDRC is about building the science capacity in, quote and quote, developing countries, to be able to do research and innovate so that local researchers and innovators are solving locally defined problems. So, it is rather kind of a different model of development, or foreign assistance, or whatever you want to call it. (Interviewee #24)

This approach can be understood within the current tendencies in international development to follow a model of development ownership (Harper-Shipman, 2019; Overton, 2019). According to this interlocutor, the idea of this program is to activate local capacity in AI research to inform national and regional AI strategies. This is supposed to be based on empirical and contextual understandings of responsible and ethical AI development from an African perspective (Interviewee #24). Development ownership is a new approach that attempts to give

more agency to local actors and sovereign states in influencing the development agenda, resources, and outcomes (Harper-Shipman, 2019). Arguably, this approach should result in greater participation by local African actors in the development of AI, and eventually address the lack of African context in AI. This interlocutor emphasized the need for including African voices in the global discussion of responsible AI.

> We're really interested in having their voices be heard on the global international discussions which is something that's missing, […] they're almost all come from OECD countries, you know, companies sitting in those countries, right. So, so you're really missing that other perspective, which is really, really important, so that we work really hard to try to ensure that they are included in those discussions, which is something sort of, you know, the Canadian government is quite actively involved in this in their foreign policy positioning around the importance of responsible AI, they started with France the GPAI, which is the global partnership on AI. (Interviewee #24)

IDRC's initiatives align with other Canadian government efforts where Canada is playing a major role in supporting the global development of responsible AI as part of Canada's international agenda. One of the major international initiatives that the Canadian government established is the Global Partnership in AI (GPAI) [12]. The GPAI is a multistakeholder initiative aims at bringing together the scientific community, industry, civil society, international organizations, and governments. The goal of the GPAI is to look at practical and applied activities on AI-related priorities globally including data governance, the future of work, and innovation and commercialization of AI.

Canada is currently the chair of GPAI and played a key role in establishing this partnership with France, bringing in other fifteen member countries of the Organisation for Economic Cooperation and Development (OECD) as founding members (Interviewee #14). Currently, the

12 https://gpai.ai/about/

GPAI has 25 countries of which are all from the Global North, except for Brazil, Mexico, and India. However, there are no members from Africa, although its membership is open and not only restricted to OECD countries. According to my interlocutor at Canada's Global Affairs, the objective of GPAI is to look at what responsible AI development looks like in the execution of concrete and applied AI projects. This is achieved by leveraging the expertise of its members countries through different working groups. These groups look at different aspects of applied AI in the areas of human rights, inclusion, diversity, innovation, economic growth, and more recently a subgroup on AI and pandemic response.

The GPAI Secretariat is hosted at the OECD to strengthen the link between the work that the GPAI does on the scientific and technical side and the international AI policy efforts led by the OECD. One of the key OECD policy initiatives for the development of responsible AI is the OECD Policy Observatory on Artificial Intelligence. It is an OECD platform for providing data and multidisciplinary evidence-based analysis for AI policy and for facilitating the development of intergovernmental standards on AI.

The Canadian government also has other initiatives looking at the intersection of foreign policy and digital technologies. For example, the Center for International Digital Policy at Canada's Global Affairs engages in multilateral and bilateral relations to shape the norms that govern digital technologies (Interviewee #11). This includes AI development in different contexts including the domains of international security, international affairs, human rights, democracy, and economic development, according to my interlocutor at Global Affairs (Interviewee #14). In this regard, IDRC develops an annual Government AI Readiness Index to benchmark AI development globally. The focus of this index appears to be measuring the preparedness of countries around the globe to deal with the perceived negative impacts of AI technology. However,

it also serves the double purpose of gauging the participation of different states in the development of ethical guidelines and policies for responsible AI.

> We fund what we call the AI Government Readiness Index, that looks at a lot of different factors. And we worked really hard with the researchers who undertook that research to make sure that they were bringing in sort of African perspectives and African case studies, and we've actually decided to shift it into being a different kind of instrument, which will be a responsible AI instrument, but part of that is very much still looking at, you know, are governments equipped to handle the risks of some of these technologies. (Interviewee #19)

The most recent index of 2020 shows an increasing involvement in benchmarking AI in Africa in contrast to the previous report in 2019. The 2020 version shows more elaborate analysis across a few countries in North and Sub-Saharan Africa that occupied 14 pages compared to only 3 pages in the 2019 report. However, the latest report does not have adequate coverage of AI development in the continent as only four African countries (Egypt, Mauritius, South Africa, Senegal) are included in this report.

Additionally, the OECD issued recommendations on responsible AI [13] (OECD AI Principles) which are adopted by the G20 in 2019. The OECD AI principles are value-based and promote inclusive growth, sustainable development and well-being, human-centred values and fairness, transparency and explainability, robustness, security and safety, and accountability in AI. However, the G20 AI principles focus on two main areas, specifically the digital economy and trade (METI, 2019). Both AI principles are framed around the SDGs focusing on inclusion in the promotion of trustworthy AI. The OECD AI initiatives are taking place in a background of a global push in international development towards sustainable development goals as established by the

13 https://oecd.ai/en/ai-principles

United Nations (UN) SDGs and Targets of 2030 (OECD, 2016). The understanding of IDRC AI4D Africa initiative can be contextualized within this broader effort to support the SDGs by the international community. For example, one of the AI4D Africa program leads at the African Center for Technology Studies (ACTS) emphasized this relation which shows how the program is configured on the ground.

> Basically, what we are doing is offering scholarships to PhD students across Africa and also offering grants to early career academics, that is those who have just finished their PhDs and who want to do a project in AI. Basically, it's mixing AI with Sustainable Development Goals area, as you know, AI is just a tool, it has to be applied in some application area. So, any of the application areas under SDGs could qualify. (Interviewee #10)

On the other hand, the development of AI in industry can be described by a similar pattern of international assistance including philanthropy and corporate social responsibility. These initiatives are spurring start-up tech hubs across the continent following a tendency in global innovation practices to replicate models of innovation (Silicon Valley and MIT) in regional innovation centres (Pfotenhauer & Jasanoff, 2017). For example, AfriLabs started in 2011 with the idea of building a collaborative community for tech hubs across Africa to facilitate knowledge sharing and funding, and networking. AfriLabs's goal is to promote technology entrepreneurship and innovation in Africa. AfriLabs does not create tech hubs as part of its mission but rather focuses on connecting existing hubs together. The focus of AfriLabs is to increase Africa's visibility and enable the continent to be part of the global knowledge and innovation marketplace which in return stimulates economic growth, according to my AfriLabs interlocutors.

Philanthropic and international assistance funding provided by the Microsoft's 4Afrika Initiative, The World Bank infoDev, and the Rockefeller Foundation was instrumental in establishing AfriLabs and supporting its strategic vision. In addition, most of the tech hubs within

AfriLabs network and across the continent followed a similar path to establish themselves. For example, iHub in Kenya, an early member of AfriLabs and a top ten tech hubs in Africa, was established by a grant from the Omidyar Network. Omidyar Network is a philanthropic investment firm founded in 2004 by eBay founder Pierre Omidyar and his wife. iHub started as a group of tech hackers and founders who wanted to have a space to work, collaborate, and co-create. According to my interlocutor, what allowed iHub to create their space is funding designed in response to the post-election violence in Kenya 2008 (Interviewee #03). This interlocutor has inside information on iHub and was a member of the early management team of AfriLabs. iHub members developed Ushahidi[14], a crowdsourcing tool that they co-create to trace violence and election fraud in Kenya at the time (Shapshak, 2016). Later, iHub received $1.4M from Omidyar to establish a hub in Kenya and scale Ushahidi (Omidyar Network, 2009).

In broader theoretical terms, philanthropy is understood as a remedy for supplementing the shortcomings of the state (Eikenberry & Mirabella, 2018; Moyo & Ramsamy, 2014; Obadare & Krawczyk, 2022). In the case of AI in Africa, a shift in traditional international assistance and philanthropic practices is taking place. International development assistance is being complemented by new forms of funding such as social impact funds, philanthropy, corporate social responsibility, and global funds. Many funding arrangements like AfriLabs' and other start-ups involve both corporations and international development agencies. Particularly, this model of private-public partnership is aimed at solving socioeconomic issues in the Global South. It focuses on issues such as poverty reduction, improving living conditions, and addressing inequalities while

14 https://www.ushahidi.com/

foregrounding commercial incentives for technoscientific innovation (Kostyak et al., 2017; Onyango, 2022; Petersen, 2016).

Philanthropy is a highly politically contested concept in Africa (Daly, 2012; Gallie, 1955; Obadare & Krawczyk, 2022). On one hand, philanthropy plays a role in imagining technoscientific futures and forms of social order (Jasanoff, 2004; Jasanoff & Kim, 2015) in the continent, as I showed from the previous discussion. However, many studies problematize this notion of philanthropy at a global scale (Aina, 2013; Al Dahdah, 2022; Barkan, 2013; Eikenberry & Mirabella, 2018; Morvaridi, 2012). For example, this approach is criticized by Eikenberry & Mirabella (2018) for moving away from philanthropy as model for positive social change to a model of neoliberal global marketplace. Morvaridi (2012) points out the hegemonic aspects of philanthropic partnerships based on existing power asymmetries. In these arrangements, powerful actors such as the donors push their visions of particular futures in the local context. Additionally, Aina (2013) argues that philanthropy does not operate in a vacuum. He emphasizes that philanthropy exists and is expressed within a social and historical context. Global philanthropy does not appear to problematize, question, or address the conditions that created the need for addressing inequality in the first place, as Eikenberry & Mirabella (2018) argue. On the other hand, some African scholars such as Fowler (2022) and Moyo & Ramsamy (2014) attempt to theorize philanthropy from an African perspective. These scholars see that philanthropy as a phenomenon is intrinsically embedded in the life cycles of birth, life, and death of many Africans. Moyo & Ramsamy (2014) argue for a model of philanthropy that is premised on African values and embodies the African identity. They argue that the African identity is strongly linked to 'philanthropic notions of solidarity, interconnectedness, interdependencies, reciprocity, mutuality, and a continuum of relationships' (Moyo & Ramsamy, 2014, p. 656). Moyo & Ramsamy (2014)

define African philanthropy as a certain type of philanthropy that is best captured by the notions of solidarity and reciprocity among Africans, and the features that accompany relational building. This includes the view that philanthropy is intrinsically embedded in the way of life for Africans. In another way, what these alternative conceptions of philanthropy attempt to do is to embed culture and relational building attributes as defining features of what philanthropy in the African context should look like. This discussion shows that philanthropy as a concept and development approach is not stable in the African context. It is open for contestation by different actors and has inherent tensions between local and global conceptions of philanthropy.

To summarize this section, I showed that the emerging AI innovation ecosystem in the continent is configured by practices of international development of Western states and philanthropy and corporate social responsibility of multinational corporations. I illustrated that AI development is framed around responsible and ethical AI to address sustainable development in Africa. In the next section, I turn my focus to local actors to discuss their visions and ideas about local sociotechnical practices of AI innovation in the continent.

6.2.2. The Lack of African Context in AI

These discourses of AI articulated by the local actors are underpinned by the notion of the lack of African context in AI. There are two main related ideas highlighted by AI researchers and practitioners about this notion. The first one refers to the lack of African AI innovations that are rooted in the local context. These innovations have the potential to compete at a global level, like innovations from Chinese companies such as Alibaba[15] and Ant Group[16] that created new markets

15 https://www.alibabagroup.com/en-US/

16 https://www.antgroup.com/en/

at a global scale. For example, an African AI researcher articulated this idea from historical perspective of exclusion and marginalization in the continent. This researcher has been recognized for establishing a community initiative to increase access to the AI field for underrepresented social groups.

> So, we want to empower ourselves to be able to be in charge of our own process of coming up with our own solution that's what I mean by decolonization is that we don't have to wait and come to be secondary. […] And so, what does that mean in terms of technology, it means empowering our people giving them the confidence that they're capable, enabling them to study the unique ways in which these technologies can be applied within their context. And also, ultimately, showing them how they can scale those technologies to other contexts beyond their, you know, community, country, society and ultimately, other parts of the world instead of waiting for the Googles and Facebooks of this world to ultimately come back and think about solutions for us. (Interviewee #16)

This articulation of the lack of African innovation underscores two aspects of this issue. The first one is around the modalities and dynamics associated with the exclusion of globally marginalized communities from dominant Western epistemic communities engaged in the production and dissemination of AI technologies. These communities in the Global South, and particularly Africa are perceived as being on the receiving end of technological development and not part of its imagination and creation process (Goldstone & Obarrio, 2017; Ndlovu-Gatsheni, 2018). The other aspect is that it is framed within the discourse of decolonizing AI while foregrounding a particular understanding of what decolonization means in this context. This conception of decolonization does not only suggest a sense of independence and rupture with the colonial legacy. It also looks at decolonization as a process of creative articulation of technological development from the margin linked to the globalization of digital innovations. This interlocutor envisions African technological solutions that have the potential to go beyond the local context

and launch Africa into global markets of digital capitalism. This articulation is not unexpected given the link between technoscientific development and trends of globalization in modernity that have been emerging in the continent since the beginning of the millennium (Enwezor, 2010; Hanchard, 1999).

The second idea of the lack of African context in AI relates to the lack of African data sets that can inform local AI research and technological development in the continent. For example, one of the AI researchers from Ghana involved with IDRC AI4D Africa program explained this in the context of agriculture. This interlocutor discussed one of the research projects in their Responsible AI Lab (RAIL) in Ghana.

> For instance, if you wanted to use the weather pattern, or you wanted to use the moisture content within the soil to be able to make a decision, you need a data set to be able to do this, most of the data sets which are available are data sets that have been collated in foreign countries […] there is difficulty in getting accurate results, because the data sets that you have are not the best. So, we need to focus on ensuring that we have tailored data sets within our environment so that our predictions can be accurate. (Interviewee #28)

The right data acquisition to inform AI models and scientific research in the continent is a general issue in the field (Carter et al., 2021; Duan et al., 2019; Kankanhalli et al., 2019). However, this issue has particular significance in the African context. This African data deficit occurs in a background of structural disparities and inequalities that has long been the defining characteristic of the scientific communities in the Global South, and specifically Africa (Harding, 2011; Mavhunga, 2017; Pollock & Subramaniam, 2016). One of the funding recipients of the IDRC AI4D Africa program offered a perspective on how local researchers are impacted by this issue. This interlocutor is working on developing deep learning techniques for early detection of crop diseases in Africa.

> We are facing that challenge of having our own data sets. And many researchers want to present their findings and just point out their views. For example, they've come up with a tool that detects crop diseases, you will see the data set, which has been collected in the US, no one is going to believe that tool […]. So many initiatives have been started so far, which focused on only collecting data sets and one example is Lacuna fund for agriculture, I happen to be one of the beneficiaries of that project. […]. So, it's not like enough, but at least we have the starting point where we can have our data set and use our data set to come up with different artificial intelligence solutions. (Interviewee #30)

What this interlocutor articulated is that this issue results in impeding the ability of African researchers to make meaningful contributions to global AI development through their work in the local context. Particularly, this issue represents a barrier into AI innovation prerequisites. More broadly, it brings attention to the ways in which globally marginalized epistemic communities get excluded from AI innovation practices.

> We need to have open data sets. And we also need to make it open for everybody and for the benefit of those who stand to be marginalized as a result of not using the right data sets to make a decision that will affect their future. [….] and how we need to respond to that is to revolutionize the availability of data such that we have diversity with reference to availability of data set, so that we can take care of the marginalized and take care of the vulnerable in society. (Interviewee #28)

On the other hand, the previous articulation of the lack of African data sets by one of the researchers at RAIL connects data access to social justice. In the view of this interlocutor, the proposal of open data is integral to responsible and ethical AI. However, the literature on open data (Kazmi et al., 2021; Morelli et al., 2017; O'Boyle et al., 2011; Runeson et al., 2021) points to the difficulty in assessing its benefits. It also highlights the entanglement of open data with the commercial objectives of multinational corporations. Runeson et al. (2021) argue that the emerging open data ecosystem is unfolding in many ways similar to the open-source software. In this sense, open data can be looked at as another business model. From this perspective, open data

ecosystems are driven by the value of data and value of collaboration with different governance models that are either public-driven, business-driven, or community-driven, as explained by Runeson et al. (2021). For example, to address some of the gaps in data collection in the continent, the Lacuna Fund[17] is co-founded by the Rockefeller Foundation, Google, and IDRC. This interlocutor (Interviewee #30) is one of its beneficiaries through a grant to support data collection in agriculture. Currently, the focus of Lacuna includes agriculture, health, and language (e.g., data sets for African indigenous languages). Lacuna data sets are open and licenced under the creative commons[18], however, the creative commons license model still operates within the framework of the copy right laws. Many scholars criticize this framework for deepening inequalities and not responding adequately to the specifics of the culture of technoscientific production in the Global South (Bhuiyan, 2014; Corbett, 2011; Hagedorn et al., 2011; Kouletakis, 2022). If not addressed properly, these gaps can result in perpetuating emerging forms of data coloniality (Benyera, 2021; Couldry & Mejias, 2019). The coloniality of data points to the continuous exploitation of African resources in the digital economy.

To summarize this section, I showed that the AI innovation ecosystem in Africa is configured by sociotechnical and technoeconomic practices of international development, global philanthropy, and corporate social responsibility of multinational corporations. These initiatives are framed around the development of responsible AI which depends on a particular deficit model of the lack of African context in the development and governance of AI technology. Frahm et al. (2022) argue that the shift to mainstreaming responsible innovation by Western actors such as the OECD relies on a model of 'democratic deficit of innovation'. This new deficit logic put forward

17 https://lacunafund.org/

18 https://creativecommons.org/licenses/by/4.0/

the lack of societal engagement in innovation governance as the main obstacle for the uptake and dissemination of new technologies (Frahm et al., 2022, pp. 174–175). They argue that responsible innovation is put forward as a legitimate "social fix" to the diffusion of technoscience. According to Frahm et al. (2022), this enables global governance institutions to claim authority over the co-production of international forms of democracy and innovation as the pillars for 'a market-liberal international order'. Frahm et al. (2022) analysis is premised on the STS constructivist tradition and the critique of technological determinism/solutionism (Jasanoff, 2004, 2016; Suldovsky, 2016; Wyatt, 2007). Their focus is on Western democracies and the Euro-American context. I extended their argument to AI in Africa and incorporated a political economy of technoscience perspective (Birch, 2013; Tyfield et al., 2017). I showed that the way in which the economic environment of AI innovation in Africa is configured impacts and is impacted by sociotechnical practices operating with this deficit logic. In the case of Africa, this deficit logic relies on histories of exclusion, marginalization, and colonialism. It also frames the lack of African context in AI as the main barrier for AI technology to address the socioeconomic issues in the continent. This also enables Western actors to influence the co-production of particular African futures with technoscience. One of the ways in which this co-production process in Africa can be apprehended is by looking at the imaginaries of the 4IR in the continent, which I discuss in more details in the next section.

6.3. Modernity, Modernization, and Industrialization in Africa

In this section, I argue that the current efforts to frame the 4IR as a new pathway towards the long-standing quest for industrialization in Africa follow patterns of technological solutionism (Black, 2021; Gamatié, 2015; Jasanoff, 2016; Onyango, 2022). These patterns are characteristic

of previous failed attempts of industrialization and technology diffusion in the continent (Masters, 2021; Mytelka, 1989; Sutherland, 2020). I start by discussing the imaginary of the 4IR and show how this development has been taken up in the continent. I examine the discourses of the 4IR as articulated by different interlocutors to understand its impact on local sociotechnical practices of AI. I then discuss the absent role of the state in AI development in the continent. I link the discussion in this section to the broader issue of industrialization in Africa. Imaginaries of the 4IR are framed around discourses of the SDGs in the continent, as articulated by many interlocutors. This effectively places industrialization, in a capitalist neocolonial world system, as a gateway to sustainable development and social justice in Africa. I problematize this understanding of industrialization as progress and modernity. I highlighted some of these issues in the previous sections. These include the lack of understanding of the local context, greater involvement by multinational corporations, foreign governments, and international development agencies. In this section, I focus on the impact of the reduced role of the state and the lack of national policies and governance on emerging AI industrialization and modernization practices in the continent.

6.3.1. The Imaginary of the Fourth Industrial Revolution

The global push for SDGs and targets is renewing a historical debate about industrialization in Africa. With the advent of AI in the continent, a connection between SDGs and AI innovation has been framed around the 4IR (Ojo, 2022; World Economic Forum, 2018, 2020; Yingi et al., 2022). This link signifies the convergence of technology and development at the nexus of innovation and industrialization in Africa. This conception was emphasized by many of my interlocutors within the AI4D Africa program (Interviewee #10, Interviewee #12, Interviewee #31, Interviewee #34). It was also highlighted within industry by many start-up founders (Interviewee

#13, Interviewee #22, Interviewee #23, Interview#26, Interviewee #27). In the previous sections, I cited many interlocutors who highlighted several AI applications related to the 4IR in areas such as agriculture, energy, education, and so forth.

As I explained in chapter two (see section 2.5.1), the 4IR refers to a paradigm shift that can be characterized by the fusion of technologies that blur the lines between the digital, physical, and biological (Schwab, 2017). Klaus Schwab, the founder and executive chairman of the World Economic Forum, articulate his vision for the 4IR in a blog post in January 2016.

> We stand on the brink of a technological revolution that will fundamentally alter the way we live, work, and relate to one another. In its scale, scope, and complexity, the transformation will be unlike anything humankind has experienced before. We do not yet know just how it will unfold, but one thing is clear: the response to it must be integrated and comprehensive, involving all stakeholders of the global polity, from the public and private sectors to academia and civil society. (Schwab, 2016)

The 4IR represents a future imaginary of a technological society where billions of people and devices have access to unlimited connectivity, data, information, and knowledge. This is powered by a multitude of 'emerging technology breakthroughs in fields such as AI, robotics, the Internet of Things, autonomous vehicles, 3-D printing, nanotechnology, biotechnology, materials science, energy storage, and quantum computing' (Schwab, 2016). Since this vision has been popularized by the World Economic Forum, there has been a rise in the 4IR discourse in both popular and academic literature. This literature discusses future visions of the 4IR and assesses its impact from social, economic, and political perspectives (Jegede & Ncube, 2021; Madden, 2020; Ndung'u & Signé, 2020; Nyagadza et al., 2022). Particularly in relation to this project, these global discourses of the 4IR have seen a serious uptake in the continent where many interlocutors identify opportunities specific to the continent that can be harnessed using AI.

> As far as the fourth industrial revolution is concerned, one area has to do with the application of artificial intelligence is in agriculture. And it comes across as a trillion dollars. I mean if we are able to effectively apply technology, to how we do agriculture in the sub-region, we really will be at the forefront as far as economic growth is concerned. And so, in terms of how we can apply AI to drive the economy, I consider artificial intelligence in agriculture to be one of the key areas. (Interviewee #28)

With the lack of necessities such as water, electricity, healthcare, education, and transportation among others, it is expected that these targeted areas to focus on the SDGs (Kanehira & Liu, 2018). This includes areas articulated by interlocutors in the interviews such as food security (Interviewee #21), renewable energy (Interviewee #40), clean water (Interviewee #35), and so forth. Therefore, it is not surprising to see the growth in the literature that examines the 4IR specifically in the African context (Benyera, 2021; Masters, 2021; Rapanyane & Sethole, 2020; Sutherland, 2020; Uleanya, 2022; Uleanya & Ke, 2019). What at stake in this imaginary for many of these interlocutors is the opportunity for the continent to catch up technologically and economically with the rest of the world. This is amplified by the sense that Africa has missed out on the benefits of the previous industrial revolutions, as articulated by the founder of one of the AI start-ups in Nigeria focusing on education.

> Africa lost out in the first, second and third Industrial Revolutions. The fourth industrial revolution is powered by artificial intelligence, and we need to reach out to more people because our people will be the worst hit by this […] we're exiting the fossil fuel era. It's a reality that's happening. (Interviewee #13)

From the perspective of the Black technoscientific discourses of modernity, discourses of the 4IR represent particular articulations between economic development and technoscientific practices of AI in modernity. These articulations reflect co-production processes in the margins expressed as sociotechnical imaginaries of the 4IR (Avis, 2018; Bowie, 2022; Schiølin, 2020; Vicente & Dias-Trindade, 2021). For example, some of the discourses that emerged out of the

interviews frame the 4IR as a silver bullet for many of the socioeconomic issues in the continent. One of the lead researchers at RAIL articulated this vision in one of the interviews.

> If you look at Africa, where most of our governments have mismanaged our resources, many of the cash crops and minerals did not help us. But if you look at it from where society is going, information is the new oil, what we've seen is that most of the youth around, are now able to trade information, and are able to make themselves self-sufficient based on the knowledge they have with information. So, within the context of Sub–Saharan African, I think that the Fourth Industrial Revolution, is the key to unlocking the potential within Sub-Saharan Africa. For instance, most of the young developers have now seen the potential in leveraging data for good and data for innovation and data to more or less generate wealth. […] we strongly believe it is the key to do the wonders that our resources could not do. (Interviewee #35)

This articulation is interesting not because it subscribes to dominant notions of the information economy and imaginaries of data (Mager & Katzenbach, 2021; Sörum & Fuentes, 2022; Toonders, 2014). Its significance lies in the fact that it highlights some of the political undercurrents in visions of the 4IR in the continent. These rhetorical visions underscore a historical lack of trust in post-colonial political institutions in the continent (Abegunrin, 2009). I expand on this point more in the next section when discussing the absent role of the state in AI development in the continent. On the other hand, this normative stance on the impact of the 4IR in the continent is accompanied by the fear of AI worsening historical conditions of inequalities, economic exploitation, and discrimination in the continent.

To bring together the discussion in this section with the previous sections, one of the African AI scientists connected to the AI4D Africa program articulated the following point in one of the interviews. This interlocutor works on several AI initiatives across several African countries addressing SDGs and looking at applications of the 4IR.

> We are sure that Africa is going to progress towards meeting Sustainable Development Goals. That's no doubt. But the trade-off between the benefits of AI and responsible use of AI is something that we need to pay a lot of attention to. It would definitely pose serious challenges on social justice and people's freedom (Interviewee #06)

In the interview, this interlocutor focused on AI in relation to the 4IR. From the perspective of this interlocutor, the application of AI as in the 4IR is critical for achieving the SDGs in the continent. This fear of AI referenced in the above quote is amplified by the global discussion on the negative impacts of AI. For example, the UN Inter-Agency Task Team (IATT) identified several AI risks that negatively impact the achievement of the SDGs. IATT is an interagency team focused on Science, Technology, and Innovation (STI) for the UN SDGs. The task team argues that sustainable development targets could be impacted by algorithmic biases, regulatory gaps on data and privacy among other issues such as income distribution and adaptive social protection schemes. Kanehira & Liu (2018) raised many issues related to the future of work, inequality across and within countries, security, and human rights. Other scholars such as Vinuesa et al. (2020) and Truby (2020) highlighted similar issues. For example, Vinuesa et al. (2020) have evaluated evidence of positive and negative impacts of AI on reaching each of the 17 goals and 169 targets of the UN 2030 agenda for sustainable development. They argue that AI could support the achievement of 128 targets across all SDGs, but it may also inhibit 58 targets. They pointed out that AI enables new technologies that improve efficiency and productivity, but it may also contribute to increased inequalities among and within countries, hindering the achievement of the 2030 agenda. Vinuesa et al. (2020) argue that the rapid development and proliferation of AI technology require the appropriate policy and regulation to be in place. This is critical to ensuring a positive outcome in the development and responsible use of AI, according to Vinuesa et al. (2020).

On the other hand, the conception of the 4IR as new paradigm shift in industrial development has been challenged by many scholars (Elliott, 2018; Peters, 2017; Sutherland, 2020). For example, Peters (2017) argues that the 4IR does not fundamentally change the nature of the earlier industrial technical system, but it fundamentally changes its logic. The technological innovations of the 4IR combined with the global reach of the system results in fundamental changes in the 'velocity, speed and scope of the system', according to Peters (2017). He argues that these technological changes focus on 'processes of abstraction, formalization and mathematization that enable and reward autonomous digital network systems' (Peters, 2017, p. 3). From this perspective, the system has become 'a single planetary technical system' that provides access to the same markets as the first industrial colonial system but exponentially speeds up all transactions, according to Peters (2017). Furthermore, Elliott (2018) points out that despite the amount of attention given to AI, automation, and robots little work has been done to understand if these technologies fundamentally change the structure of work and the economy. He argues that this question cannot be answered by only bringing current dominant perspectives of computer scientists about the technology and observations of economists about past changes in the labour force. He emphasizes that this requires interdisciplinary perspectives to properly understand the nature of this technological change (Elliott, 2018).

However, what appears to be missing from discussions of responsible AI in the continent is the politics of international relation, given the push for the globalization of AI innovation practices (Masters, 2021). To contextualize this dimension of AI, the efforts of Global Affairs and IDRC need to be situated within these global discussions on AI. As I discussed in the previous section, Global Affairs is taking a social justice angle in the global development of AI through their work within the international groups in the GPAI. For example, issues of human rights,

citizens' empowerments, freedom of voicing concerns, and participation in processes of policymaking are central to the agenda of Global Affairs, according to one of my interlocutors at Global Affairs (Interviewee #14). However, this interlocutor stressed the point that the GPAI's approach is to empower civil society to have these conversations with local and national governments while avoiding setting the agenda for them but rather amplifying their voices.

On the other hand, IDRC is formally recognized as an arm's length crown corporation, which means it is not subject to government's human resource and administrative policies that apply to other Canadian government departments. This seemingly gives IDRC a lot of latitude into how it can go about the deployment of their development programs such as the AI4D Africa program. However, in practical terms, IDRC's initiatives are informed by Canada's foreign policy and international development agenda. There is a level of coordination that occurs to align the activities and programs at Global Affairs and IDRC (Interviewee #24, Interviewee #11, Interviewee #14, Interviewee #19).

> So, a lot of it is around just trying to coordinate, and see where there are things, because we are part of Canada's foreign assistance envelope. So, it's important to understand what we're doing. And, you know, we share the same sort of values and everything. (Interviewee #24)

The global cooperation and collaboration around responsible AI development are inherently marked by power asymmetries that is characteristic of global politics and international relations (Abegunrin, 2009; Elshakry, 2010; Oyedemi, 2019; Roberts, 2011). The previous discussion shows that there is a political dimension to the global development of responsible and ethical AI. McMichael (2016) argues that development in globalization is a political construct that is created by dominant actors such as states, multilateral institutions, corporations, and economic coalitions and is based on asymmetrical power arrangements. As I mentioned earlier, the Canadian

development approach within the AI4D Africa program follows a model of development ownership (Harper-Shipman, 2019; Overton, 2019). Development ownership is a response to growing critiques that post-colonial development practices in international assistance and development are reinforcing the colonial legacy in the Global South. However, this model has been criticized by development studies scholars as being ostensibly portrayed in international development programs but never practically materialized on the deployment of these programs on the ground (Harper-Shipman, 2019; Murray, 2018; Overton, 2019). To overcome this challenge, it is crucial for African states to collaborate and coordinate their efforts. It is also critical for Africa to assert a particular kind of African autonomy in the negotiation of international governance of digital technologies including AI. This is critical for mitigating a peripheral role for Africa in the international structure of knowledge production (Masters, 2021). It is also crucial for ensuring a transformational role rather than a transactional role for digital technology and AI innovation in the continent.

To summarize, in this section, I showed that AI development in the continent is underpinned by a sociotechnical imaginary of the 4IR. This imaginary gives rise to normative discourses of the social and economic impact of AI on the continent. These discourses subscribe to dominant Western conceptions of a continent that is lagging in terms of technological advancement, economic development, and social progress. In this sense, AI is envisioned as the solution vis-à-vis the 4IR. In the next section, I discuss the role of the state in this development as an entry point to think about the governance of AI in the continent.

6.3.2. The Absent Role of the State

In this section, I discuss the absent role of the state in the development of AI in Africa. I use this discussion to think about alternative ways to look at the socioeconomic implications of digital technology, AI, and industrialization in the continent. This section is a precursor to the next chapter, where I expand on this discussion to reimagine different possibilities of AI governance. The discussion in this section situates the lack of African context in AI development within the larger political and economic environment of technology innovation in the continent. This environment can be characterized by the absent role of the state in developing the appropriate national policies and supporting technological innovation in the continent. Many interlocutors expressed concerns about the lack of involvement by national governments, leaving the AI innovation space in Africa for Western actors to set the agenda. They expressed the need for African leaders to be in the forefront of AI development to ensure the building of AI systems that can positively impact the lives of people in the continent.

> The government has to be involved in terms of, you know, taking a lead in some of these conversations. I don't know if that's going to happen. I mean, like I said, try not to think too much about the government meaningfully, but for things like that, you know, having a voice and policy for what does AI mean for Africa? African leaders have to be at the forefront of that, but unfortunately, they are missing. So, I don't know what can happen in the continent in terms of building AI systems that can impact the lives of people. (Interviewee #18)

Many interlocutors raised similar concerns about the influence of foreign funding from big tech companies and international development agencies on AI development in the continent. With the lack of transparency in the decision-making process on both sides (donors, and local institutions and governments), some interlocutors are wondering about how priorities are determined. They argue that a lot of these AI initiatives do not reflect the local context. The issue

for many interlocutors including the one quoted above, is not only about technological domination and market monopolies given the involvement of powerful players in the scene (Birhane, 2020; Kwet, 2018; Oyedemi, 2019). However, it also has to do with the reliance on foreign assistance as an approach for national and regional development in Africa. As another interlocutor expressed (Interviewee #18), this form of dependence will only get Africa so far. In the view of this interlocutor, these AI strategies are based on what donors are willing to spare as opposed to national policies that place people at the core of the policy discourse.

> Most Sub-Saharan African countries seem to rely on donor support to even come up to fund exercises that geared towards formulating policies. It is GIZ which is funding the national AI policy formulation for Ghana. Why can't the governmental bodies fund initiatives like that? So, goodwill from the side of politics seems to be a problem. If a foreign party or foreign partner is sponsoring an agenda? Of course, there might be some of the Indigenous who have some fear factor towards that outcome. [….] but they say funding is a problem and then we mostly rely on donor partners to do some of the basic things that we should do (Interviewee #35)

This example, mentioned by one of the main researchers at RAIL, underscores the overall diminishing role of the state in the continent in creating a favourable environment for technological innovation. It indicates the lack of government's commitments to fund its own policy development, as raised by this interlocutor. This echoes what Abegunrin (2009) points out as the irony in development in Africa. He argues that 'the resources and the blueprint that Africa desperately needs to launch itself into the global economy already exist in Africa' (Abegunrin, 2009, p. 195). However, the continent has been plugged under 'uncommitted, unpatriotic, corrupt, and visionless leadership', according to Abegunrin (2009). Notwithstanding the normativity in the previous assertion, the important role of the state in supporting innovation is well documented in the literature (Block & Keller, 2015; Habiyaremye et al., 2020; Mazzucato, 2013; Scerri & Lastres, 2020).

> So, there are tech hubs, there are programs and philanthropic investors who are trying to support entrepreneurs, but there are others who would argue that these ecosystems aren't quite ecosystems and that still there's a need for more support for start-ups and things like that, to drill down on that point, historically, ecosystems develop when there's like a first generation of successful founders (Interviewee #03)

Despite the growth of the tech innovation hubs in Africa (Boucher, 2016; Giuliani & Ajadi, 2019), the state is needed to establish other components of the innovation ecosystem. This growth trend in tech hubs signals what Pfotenhauer & Jasanoff (2017) conceptualize as the practice turn in innovation. The practice turn describes the diffusion of innovation globally based on a best-practice model (Silicon Valley, MIT) on a regional basis, according to Pfotenhauer & Jasanoff (2017). They argue that this is another way sociotechnical imaginaries manifest themselves in a local context as travelling imaginaries of innovation and that these contemporary models of innovation discourse 'add a dimension of global circulation to capture how innovation policy simultaneously mobilizes local understandings of what constitutes a desirable sociotechnical future and a set of transnational practices that legitimize innovation as a global policy imperative' (p. 417).

Pfotenhauer & Jasanoff (2017) conceptualization of the "practice turn" underscores the need for looking at the local constructions of the concept of innovation while paying attention to power asymmetries in the global political economy of innovation. However, it does not adequately address the economic environment in which these dominant models of innovation are replicated in the Global South. The cases Pfotenhauer & Jasanoff (2017) discuss involve state actors and national institutions in the deployment of these innovation models in the local context.

In the previous sections, I showed that the model of innovation in Africa is operating within a different political economy that is configured by practices of international development, philanthropy, and multinational corporate social responsibility in the continent. The implication of

this observation is that the absent role of the state and national institutions in sociotechnical practices of innovation contributes to further fragmentation of emerging innovation ecosystems in the local context. This fragmentation renders innovation practices incapable of responding to the needs of the local context.

In the case of innovation, the state has a critical role to play. For example, the development of an innovation ecosystem requires considerable support by the state to create an entrepreneurial environment that can bread the first generation of founders my interlocutor earlier alluded to. An innovation ecosystem has many key components. These include a group of local actors, dynamic processes, entrepreneurial culture, finance providers, large established companies, start-ups, customers, top-level universities and research institutions, and local knowledge and competencies, according to Oksanen & Hautamäki (2014). This might seem like a general point and not unique to the African context. However, the lack of institutionalized innovation environment in the continent hinders the efforts of entrepreneurs to create new impactful companies and impede the establishment of innovation ecosystem capable of addressing the local context. This is further complicated by the lack of comprehensive government strategies for creating the required enabling environment. National governments have a key role to play in this process. As my interlocutor indicated:

> It's really tough, […], Silicon Valley was essentially funded by government. It was government money given to Stanford and whoever else did grow, develop government projects that lit the spark for Silicon Valley. And so arguably, you could say the same thing about Israel's start-ups. But when you look to the governments of the continent, you're not really seeing that level of enablement. In fact, what it looks like, from the outside looking in, is that government seems to be actively shutting down avenues of opportunity for innovators who are trying to create it. So in an ideal world, the government would provide quite literally the enabling environment. (Interviewee #03)

The popular perception is that hi-tech companies such as Apple, Google, Facebook, and so forth play a significant role in establishing ecosystems. To the contrary, these companies are a product of a long history of government and defence spending that helped in sustaining an entrepreneurial culture and economy in the Bay Area (Klepper, 2010).

The development of AI in the continent can be characterized by efforts to modernize the industrial and agricultural sectors using AI innovations. However, Africa has been pursuing industrialization since independence with very little success (Dibua, 2017; Mytelka, 1989). With the majority of its population living and depending on the rural economy, the sustainability of industrialization practices is one of the key challenges of the continent (Ahmad et al., 2022; Kingiri, 2022; Sampath, 2016). This situation requires the problematization of new conceptions of industrialization as a development pathway for the prosperity of these communities. It also requires serious consideration for the reimagination of industrial practices in support of rural development. To illustrate this issue, I bring a point raised by one of the discussants at ACTS workshop on *Using African Agricultural Innovation Systems for Rural Development*.

> We are talking about the fourth industrial revolution, we are talking about using a lot of digitalization and high technology, we are talking about sophisticated AI innovations […] when we pursue that, we also create inequality, mind you the greatest percentage of households are in rural areas in remote areas, those are the people who lack access to resources. […] So, when we want to increasingly project digitalization agenda, it is kind of creating inequality for these farmers. […] So, it will only be these large commercial farmers who have access to almost all the resources, they have access to finance to participate in these technologies […] inequality in agriculture is a threat to sustainable development. (Field Notes, March 3, 2022)

Habiyaremye et al. (2020) show the pivotal role of the state in creating the required economic and political environment necessary for bridging the gaps between innovation producers and rural communities. They highlight the important role that the state plays in structural

transformation. On the other hand, Ndlovu & Makoni (2014) show that innovation and development focused on the local context is not a natural panacea for socioeconomic issues in the local context. To the contrary, in many cases these local approaches could further exacerbate inequalities when they are implemented in highly socio-spatially fragmented and economically uneven societies. Particularly, in the case of AI in Africa, Amankwah-Amoah & Lu (2022) outline a set of challenges for AI adoption in the continent. The barriers to AI innovation in the continent discussed by Amankwah-Amoah & Lu (2022) can be conceptualized in two related areas, the lack of proper institutional infrastructure and lack of national investments in capacity building. This understanding is further supported by what Barro (1991) found long ago based on his empirical investigation into the patterns of growth of the economies of low-and-middle income countries. He argued that institutions matter decisively into determining growth patterns and the success and failure of such economic transformation initiatives.

6.4. Conclusion

In this chapter, I examined the political economy of AI and innovation and showed how the AI innovation ecosystem is configured in Africa and its implication for the development of an AI ecosystem in Africa. I argued that this emerging ecosystem can be characterized by growing involvement from the international development community and multinational corporations in developing AI technological capabilities and increasing the level of AI sociotechnical innovation practices in the continent. I also showed that the majority of AI development is framed around responsible AI and social justice highlighting global and local inequalities and development disparities. Most of the AI development is concentrated in the areas of capacity building in terms of infrastructure and talent development for both scientific research and applied AI for commercial

applications and market development. I also argued that the understanding of this development of AI in Africa should be contextualized within the global push for SDGs and the 4IR at the nexus of development and technology in the continent.

With the growing concerns over the negative social and economic implications of AI, Western social actors are increasingly promoting responsible innovation in the Global South (Frahm et al., 2022; Hanemaayer, 2022). This is taking place in a background of rising global universalist discourses of AI ethics, as discussed in the previous chapter (see section 5.2). Consequently, responsible AI is framed as a double remedy to technological backwardness of low-and-middle income countries, perceived as lagging on global AI innovation while simultaneously addressing publics' concerns about AI and its many discontents. I argued that the framing of responsible AI in the continent relies on a deficit model of the lack of African context in AI as the main barrier for AI to address the socioeconomic issues in the continent. Ironically, this deficit logic provides legitimacy for Western actors to intervene through international assistance programs and influence the co-production of African technoscientific futures and visions of particular social order in the continent. I showed that these AI efforts are operating within an international development framework in a capitalist neocolonial world system. This model foregrounds new ideas of industrialization in Africa and technological fixes to the economic and social challenges in the continent, despite well-established criticism of this notion (Irani et al., 2010; James, 2010; Philip et al., 2012).

Bringing this chapter and the previous chapter together, the notion of the lack of African context in AI and the sociotechnical imaginaries of decolonizing AI come together to create the conditions for this developmentalism thinking in AI. This mode of thinking is influencing the discourse of AI governance in the continent. In the next chapter, I discuss in more details AI

governance issues and look at how AI governance should be approached in the continent. For example, the ideas and visions of AI development by the international development community and local proponents of AI highlight tensions between global narratives of AI and local visions of developmentalism. These global visions frame development as a vehicle for progress and prosperity in a capitalist neocolonial world system. In this chapter, I showed that the development of AI in Africa represents a particular development paradigm in the continent. This model deploys responsible innovation discourse while foregrounding globalization in support of national sustainable development goals. This approach relies on close collaboration between the market and the state in achieving global and national objectives of development. However, local articulations demonstrate that concerns around the social and economic implications of AI must be geographically situated taking into account the historical trajectories of development and economic oppression in the continent (Ndlovu & Makoni, 2014; Rodriguez, 2011). The discussion in this chapter showed that these discourses also highlight the need for close examination of the politics of local and global AI innovation practices at the intersection of international relations (Masters, 2021). In the next chapter, I problematize this orientation in global development discourse and discuss alternative possibilities to think about a different AI governance approach from the perspective of Black technoscientific discourses of modernity.

7. AI Governance from Below: Contested Visions of Pan-African Development

7.1. Introduction

In the previous two empirical chapters, I focused on knowledge production (chapter five) and the political economy (chapter six) of AI in Africa. In this chapter, I turn my focus to the politics of AI and contemporary debates and ongoing controversies over state-building in post-colonial Africa. In chapter five, I showed that with the growing concerns over AI and its many discontents, the topic of decolonization has become more salient within the AI field given the language du jour in AI ethics. I discussed the different Black technoscientific discourses of decolonizing AI in modernity and examined how decolonization is understood by the different institutions and actors in the AI community in Africa. I argued that decolonizing AI has become a sociotechnical imaginary about the different contested technoscientific futures in the continent. In chapter six, I examined the political economy of AI innovation in Africa in the contexts of international development and commercialization. I contended that much of the AI development in Africa is underpinned by different understandings of the lack of African context in AI with many overlapping technoscientific discourses between the two streams of AI development in the continent. I argued that despite increasing efforts by Western actors to seemingly integrate the African AI ecosystem into the global centres of AI innovation, African AI communities continue to be excluded from globally dominant AI epistemic communities and AI innovation prerequisites.

In this chapter, I turn to AI governance in Africa not only as an issue about the development of responsible AI innovation in the continent, but also as a controversy surrounding technological sovereignty and politics of technological innovation that has its roots in state-building and histories of decolonization after independence in Africa. Technological sovereignty has wide-ranging

conceptualizations and overlapping definitions as data, digital, and Internet sovereignty. It is differently mobilized in different contexts (law, policy, politics, infrastructure) by different actors (states and governments, activists, civil society organizations, and Indigenous groups) to examine issues of power and politics at the confluence of technoscientific innovation and global digital capitalism (Couture & Toupin, 2019; Edler et al., 2021; Hernandez Fuentes, 2022; Lynch, 2020; March & Schieferdecker, 2021; Maurer et al., 2015; Morozov & Bria, 2018; Ribera-Fumaz, 2019; Schieferdecker & March, 2020). In this dissertation, I privilege Couture & Toupin's (2019) notion of technological sovereignty as a way to 'describe various forms of independence, control, and autonomy over digital infrastructures, technologies, and data.' (Couture & Toupin, 2019, p. 2305).

In this chapter, I approach the discussion of AI governance in Africa by comparing two Pan-African imaginaries of AI. The first one is a "rational" imaginary that mobilizes normative discourses of technoscience and innovation to envision economic development and progress in Africa as a modernist project in a globalized world. The rational imaginary conveys technoscientific and commercial rationales. It transforms characteristics of the African context into development and economic opportunities to attract development funds and commercial investments from multinational corporations and international development agencies attempting to make a dark continent more legible to global centres of AI innovation and financial markets. I examine this imaginary by tracing the evolution of the political culture of the African Union (AU), as the foremost Pan-African institution, and looking at its technoscience and innovation policy. The second one is a "relational" imaginary that mobilizes Black technoscientific discourses of modernity to reimagine AI development in Africa as a Pan-African project about technological sovereignty and reclaiming of the development agenda in Africa. The relational imaginary makes claims to African knowledge production practices and African ways of knowing and being in the

world. From this perspective, this imaginary is relational in the sense that it makes knowledge claims in relation to particular African futures that foregrounds ideas of relational autonomy (Ikuenobe, 2015). The idea of relational autonomy looks at the person as a 'socially constituted and embedded in a social environment, culture, or tradition that indicates value commitments, social obligations, interpersonal relationships, and mutual dependencies' (Ikuenobe, 2015, p. 1005). In another way, this African view of relational autonomy rests on communal realities, relationships, values, interests, obligations, and modes of meaning embedded in African knowledge traditions. I examine this imaginary by looking at the political discourses of AI as articulated by different social actors working on different AI initiatives and projects in the continent such as developing AI Natural Language Processing (NLP) models for African indigenous languages and AI infrastructure for low-resource computing settings.

I argue that the rational imaginary of AI reveals universalist and imperialist modes of technological innovation as it ignores other approaches of AI development that do not adhere to Western dominant conceptions of modernity, technoscientific capitalism, economic competitiveness, and neocolonial world system. On the other hand, the relational imaginary offers a way out of this conception of AI development by representing an alternative vision of AI governance from below detached from Western terrain of modernity and rationality of technological progress and commercialization success. Instead, the relational imaginary aligns AI development in the continent with the struggles of the African epistemic communities for epistemic freedom and reimagination of the future in Africa. I contend that what at stake in these Pan-African imaginaries is the vision of state-building as a post-colonial project in Africa.

In the next sections, I build on my discussion of Pan-Africanism that I outlined in chapter five (see sections 5.2 and 5.3). I trace the evolution of contemporary conceptions of

technoscientific Pan-Africanism in the discourses of AI development in the continent to situate my arguments within the context in which these two imaginaries emerge (Jasanoff & Kim, 2015). I then examine both Pan-African rational and relational imaginaries and discuss the implications for AI governance and innovation policy in the continent. As the accounts of my interlocutors in this chapter illustrate, I contend that one of the more fruitful and productive ways of approaching AI governance in the continent is to look at AI development as state-building experiment in postcolonial Africa (Bonneuil, 2000; Elliott & Koech, 2018). The goal of this chapter is not to devise a specific AI governance or ethics proposal but rather argues for an approach that locates discourses of AI technological innovation in Africa within their colonial and post-colonial continuum in terms of notions of progress and modernity using technoscience and innovation while centring the political imaginations of the different African AI communities alongside the materialities of AI technology as an imperative for creating an effective governance model of AI in Africa that is capable of enabling AI benefits while addressing the negative impacts of AI innovation in Africa.

7.2. Modern Discourses of Pan-African AI

As I argued in chapter five, historically, decolonization in Africa was understood as transfer of power from the metropolis to former colonial possessions and as a complete rupture with the institutions, structures, and ideas of Western modernity. I showed this by tracing the development and evolution of Pan-Africanism in thought and practice in the continent. I discussed the Pan-African technoscientific discourses of modernity as articulated by the Organization of African Unity (OA) and its successor the African Union (AU) and Africa's political and thought leaders in the post-independence era.

In this section, through a discussion of the AU Agenda 2063 technoscience and innovation strategy, and AI discourses articulated by different social actors from different African institutions, I trace the evolution of the imaginary of modern Pan-African technoscience in AI development in the continent. I argue that there are two emerging strands of contemporary Pan-African thinking when it comes to technoscience and innovation. The first one is a rational Pan-Africanism imaginary of development that makes claims to capitalist ideals of economic progress and prosperity. This imaginary mobilizes technoscience discourses of globalization and expresses a desire to move the continent away from an era of colonial struggle and recasts Africa as a global player in a neocolonial world system. The second one is a relational Pan-Africanism imaginary of development. This imaginary asserts a vanguard role of Pan-Africanism in the political, economic, and social struggles in the continent against contemporary technoscientific capitalism, while mobilizing and reimagining alternative technoscientific futures in the continent.

7.2.1. The Rational Imaginary of Development

The rational imaginary is particularly revealed by examining the vision of continental development underpinning the AU technoscience and innovation strategy. This strategy came as a result of the AU Agenda 2063. In 2013, fifty years later after the founding of its successor (OAU), the AU called for a new vision, a new path for attaining inclusive and sustainable economic growth and development in the continent. As a result, Agenda 2063 was born and adopted later in 2015 by its members states. The main idea of the AU 2063 vision is a shift from the anti-colonial struggle to social and economic development in a globalized world where smart technologies including AI play a pivotal role in an overarching vision of an African Renaissance. This development agenda attempts to centre a new Pan-African imagination of the future under the banner of African

Renaissance with technoscience and innovation as the main propellers to move the continent forward. Dr. Martial De-Paul Ikounga, the Commissioner for Human Resources, Science & Technology of the Africa Union Commission, articulates in his introduction to STISA-2024 that the 'AU Agenda 2063 is underpinned by science, technology and innovation as multi-function tools and enablers for achieving continental development goals.' (African Union Commission, 2014). In this new vision, the AU emphasizes that Pan-Africanism as an approach has a strategic role in achieving its development objectives. Agenda 2063 has seven aspirations for the continent to achieve economic transformation, progress, and prosperity. The second aspiration calls for 'An integrated continent, politically united, based on the ideals of Pan-Africanism and the vision of Africa's Renaissance' (African Union Commission, 2015). An important undercurrent in this vision is the AU shift towards more of a globalization vision.

> The world-class infrastructure, accompanied by trade facilitation, will see intra-African trade growing from less than 12% in 2013 to approaching 50% by 2045. Africa's share of global trade shall rise from 2% to 12%. This will in turn spur the growth of Pan-African companies of global reach in all sectors. (African Union Commission, 2015)

The call for Agenda 2063 came after the tenth anniversary of the renaming of the OAU to the AU and its relaunch in 2002, signalling a shift in the political orientation of the Pan-African organization towards a new era of global politics. Contemporary development pathways in Africa has been shaped and impacted by globalization processes, and decades of structural adjustments mandated by neocolonial global institutions as part of their international monetary and development policy (Abegunrin, 2009; McMichael, 2016). Although, globalization has been conceptualized in different ways in terms of culture, politics, and the economy and perceived as a recent phenomenon. However, globalization as a "development project" has its deep roots in

histories of colonialism and has been an ongoing process for centuries (McMichael, 2016; Stiglitz, 2017). Contemporary forms of globalization refer to 'myriad forms of connectivity and flows linking the local (and national) to the global – as well as the West to the East, and the North to the South' (Steger, 2013, p. 2). However, as I discussed before (see section 6.2.1), McMichael (2016) argues that development in globalization is a political construct that is created by dominant actors such as states, multilateral institutions, corporations and economic coalitions and based on asymmetrical power arrangements. From this perspective, globalization can be conceptualized by ideas of corporatization as a vehicle for spreading the influence of capitalism (Quist-Adade & Royal, 2016; Stiglitz, 2017). Contemporary forms of global technoscience Pan-Africanism can be seen in the discourses and practices of the AU and the positioning of STISA-2024. In this document, the AU lays down its vision of technoscience and innovation strategy.

a) Enhance effectiveness of Science, Technology, and Innovation (STI) in addressing/implementing priority areas.
b) Improve technical competencies and institutional capacity for STI development.
c) Promote economic competitiveness through fostering innovation, value addition, industrial development, and entrepreneurship in synergy with instruments such as the Action Plan for Accelerated Industrial Development of Africa (AIDA) and Pharmaceutical Manufacturing Plan for Africa (PMPA).
d) Protect knowledge production (including inventions and Indigenous knowledge) by strengthening Intellectual Property Rights (IPR) and regulatory regimes at all levels
e) Facilitate STI policy reforms, harmonization, science diplomacy and resource mobilization.

(African Union Commission, 2014, pp. 24–25)

STISA-2024 specifies Information and Communication Technologies (ICT) among other sectors such as Agriculture and Food Security, Biosciences, Natural Resources, Public Health, Human Studies, and Governance and African Integration as the top sectors that will transform Africa into "knowledge-based and innovation-led society". Together, these sectors are poised to

address the strategy priority areas including eradication of hunger and achieving food security, prevention and control of diseases, communication (Physical & Intellectual Mobility), protection of African space, building the society, and wealth creation. In particular, the vision for building the society is achieved through strong governance, entrepreneurship, technoscience, and innovation, as stipulated by STISA-2024.

> STI will help strengthen the capacity of AU Member States to build necessary infrastructure, train future generations of political and social leaders, business people and entrepreneurs, scientists and researchers, and leverage STI for sustainable socio-economic development. (African Union Commission, 2014, p. 23)

A noticeable reorientation in the AU strategy is the increased emphasis on the involvement of the private sector, and the role of entrepreneurship to deliver on the STISA-2024 objectives. Dr. Ikounga emphasized this by saying that 'accompanying and supporting African move towards increased innovation, the private sector has a role in identifying and supporting new opportunities.' (African Union Commission, 2014). The featured example by the AU for the implementation of its technology strategy efforts is the SMART Africa Alliance[19], an alliance of 32 African countries, international organizations, and global corporations. Championed by Rwanda's president, Paul Kagame, SMART Africa was created in October 2013, to accelerate socioeconomic development through ICTs nationally and continentally. The alliance includes big tech companies such as Google, Facebook, Microsoft in addition to several global hi-tech companies such as Intel, Huawei, Ericsson, TATA, HP, and financial and international development agencies such as the World Bank, and GIZ. The alliance also attracted several African organizations ranging from start-

19 19 https://smartafrica.org/

ups and Venture Capital (VC) companies to regional innovation tech hubs such as AfriLabs. An interesting observation is that the structure of the alliance mimics very much a partnership model of a large corporation in the tech sector with different levels of partnerships arrangements ranging from platinum to silver and grouped into corporate, academic, and partner organizations. However, the alliance has not produced much so far considering that one of its mandates is intercontinental tech governance models, and standardization including in areas such as mobile communication and Open Data initiatives.

The STISA-2024 strategy stipulates that Collaborative Open Innovation and Entrepreneurship is essential to achieving the knowledge economy and sustainable socioeconomic development across Africa. It specifies certain measures including public-private sector collaboration (at both national and regional levels), systematic technology transfer and knowledge sharing, co-creation and adaptation of new products, services, processes, business models and policies, and commercialization of research and innovation outputs. These measures are meant to stimulate the local, national, and regional innovation ecosystems, improve public services (including entrepreneurial innovation based on Open Data), create new economic sectors and wider employment opportunities in the formal economy, and commercialize technologies with regional relevance and global potential, according to the STISA-2024.

Open data has become essential for creating the knowledge-society, as aspired to by STISA-2024. However, as I discussed before (see section 6.2), open data and open innovation in the Global South and particularly Africa, often sediment exclusionary and monopolistic practices of multinational corporations. Wessels et al. (2017) argue that open data requires a new sociotechnical data ecosystem and a new configuration of institutions that are capable of mobilizing data across a data ecosystem and society. On the other hand, Open Innovation has been

criticized in the context of emerging markets in the Global South as being used for Reverse Innovation. It is seen as a new exploitative strategy by multinational corporations to innovate in emerging markets and then to further exploit the profit potential of such innovations by subsequently introducing them not only in other similar markets but also in developed markets (Malodia et al., 2020, p. 1009).

The discussion on open data and open innovation could be linked to many explicit expressions of Pan-Africanism made by several interlocutors, specifically when the issue of infrastructure and capacity building came up in the interviews. Many of the interlocutors discussed what they referred to as the common problems of Africa. They see the only opportunity for Africa's technological advancement in AI is through the possibility of sharing resources, expertise, and infrastructure. For example, researchers from the RAIL lab in Ghana are working on different collaborations across several African countries including Ghana, Senegal, Benin, Gambia, Rwanda, and Burkina Faso. The sentiment is that this kind of collaboration is useful and brings much needed solutions to issues in areas as diverse as agriculture around pest control to renewable energy in terms of energy masses prediction and energy mixes. However, one of the important missing strategies that they identified where the AU has not shown serious and genuine efforts in fostering open data and open innovation is in developing AI guidelines and governance frameworks, specifically around data. They highlighted the important issues around cultural differences between African countries and the variances in national policies of technoscience and innovation that could hinder these efforts, which requires more concerted effort that only a Pan-African organization such as the AU can address (Interviewee #32, Interviewee #35).

Additionally, another key area that is identified as critical by the STISA-2024 strategy is the improvement of African competitiveness in global research and innovation, and STI technical

competencies. The strategy emphasizes that the policy focus should be on capacity building including postgraduate programs leading to doctoral qualifications, research-intensive higher education institutions, multi-stakeholder Centers of Excellence, and popularizing STI research and innovation as potential career paths. Programs such as the AI4D Africa align with the AU strategy. However, there seems to be lack of integration between the STISA-2024 activities and other civil society organizations and expert groups in the continent who have competency and interest in undertaking part of the strategy and support its activities. For example, ACTS has the capacity to work on the AU strategy, however, there is lack of clear mechanisms by which this can be accomplished.

> We should work with the structures that are there, the African Union Development Agency out there, for instance, I think within that platform, then they could form a Pan-African kind of platform, where we exchange ideas around artificial intelligence, we do have already what they call eminent scholars, I mean, like our committees, which are formed to deliberate on specific issues. I think there could be quite a number, but I think they are disjointed. And then there'll be one central point where there'll be some kind of coordination of information, coordination of activities, committed to be more efficient. (Interviewee #12)

On the other hand, the inclusion of the diaspora in the AU Agenda 2063 is interesting at this juncture of globalization. However, the AU failed to have a clear vision for how this could be realized in its strategic technoscience and innovation planning. The STISA-2024 does not account for the diaspora as a source of untapped capabilities and technoscientific knowledge, even though Agenda 2063 envisions the inclusion of the diaspora as part of its strategic approach. This is a missed opportunity to address the issue of brain-drain in Africa that has been plaguing the continent for a long time. A new strategy of Pan-African integration at a global scale could prove fruitful to addressing this issue (Mavhunga, 2018). For example, Quist-Adade & Royal (2016) see that with the help of information technology and other modern technologies, the issues of brain-

drain can be turned into a positive gain by facilitating the political, economic, cultural, and social integration of continental Africa with its sixth region. As Clapperton Mavhunga argued in a seminar about STISA-2024 in Pretoria, South Africa, it's time to think about brain-drain in Africa as brain banking and brain repatriation (Grossberg, 2015).

In the previous section, I showed that the OAU articulated modern technoscience Pan-Africanism ideas and thought through conceptions of African socialism that dominated African politics in the post-independence era. As I explained in the previous section, African leaders and Pan-African thinkers of African socialism saw communalism as the prerequisite for development in the continent. However, the emerging form of rational imaginary of modern Pan-Africanism is articulated with ideas and visions of competitiveness and progress that appeal to neocolonial world system and shift towards global markets orientation and capitalist ideals of technoscientific innovation, economic development, and social progress. While many of the statements in the STISA-2024 strategy foreground an understanding of technoscience and innovation anchored on Pan-African imaginary of united Africans in Africa and the diaspora. However, these visions clearly articulate a globalization shift in the AU approach to Pan-Africanism that conveys technoscientific and economic rationales for its development vision. The STISA-2024 document lays out a modernist vision of development in the continent. It shows globalization tendencies as articulated by the AU, as a new conception of Pan-Africanism that mobilizes technoscience including emerging technologies such as AI to envision a new pathway for Pan-African development and economic progress. This is happening in a backdrop of increased technoscientific capitalism in the current moment of globalization.

It has been almost nine years now since the launch of STISA-2024 and little has been accomplished by the AU. This is evident from the interviews I conducted and the previous

discussion where I showed the lack of the AU response on making reasonable progress in addressing the concerns highlighted by its technoscience and innovation strategy around governance, capacity building, and integration of civil society and the diaspora. This has implications for the credibility of the AU, considering the political climate in the continent. In the eyes of some of my interlocutors, the AU does little to Pan-African development. For example, a policy analyst from Kenya, indicated that 'we had the AU all along and it became almost irrelevant until it had to change its name to rebrand itself' (Interviewee #33).

> This AU thing to me is rubbish, [……], this is just another bureaucracy for people to create some jobs. Every time you have intellectuals, they will collaborate whether the thing is structured or not…… if we all develop good strong universities, we don't need a structure … to be told how to have AU or whatever ….. If we only develop the institutions and strengthen them and support advance research, networks will come out on their own without you having all this, so to me, I don't think it is necessary. What I'm trying to say if you do things right. It will work.

STISA-2024 is not perfect, nor that it should be thought of as such. STISA-2024 could provide a platform from which scholars, practitioners, policymakers, politicians, and many other social groups can initiate a productive dialogue about what technoscience and innovation means in Africa (Mavhunga, 2017). However, the current STISA-2024 strategy subscribes to dominant narratives of technological globalization the globalization of Western technoscience and innovation and universalist approaches to technological development, social progress, and economic prosperity (Kellner, 2002; Lippit, 2005). As I discussed before (see section 2.4.2), the emergence of Western science as global and universal was a result of historical processes of appropriation, amalgamation, and erasure of other knowledge traditions across the world (Elshakry, 2010). On the other hand, the enterprises of technoscience have been central to empire projects since early colonialism to the present moment of neocolonialism. However, the modern

notion of the "global" today denotes the interconnectedness of the world through forces of capital, trade, and markets (Suarez-Villa, 2012). AI development and technological innovation are tied in many ways to financialization practices of technological innovations and global capitalism. Fuchs (2016) argues that multinational tech corporations are operating globally and forming one of the most concentrated economic sectors in contemporary capitalism. With the current form of the AU technoscience and innovation strategy, the Pan-African organization is drifting away from Nkrumah's vision that it claims to be working towards achieving it in the continent (African Union Commission, 2014, p. 5). In fact, the AU's reliance on global neocolonial financial institutions, multinational corporations, and international development agencies for financing its Agenda 2063 strategic initiatives runs contrary to that vision. Nkrumah pursued a vision of African autonomy and complete independence of Africa's economic systems and political policies (Nkrumah, 1964, 1965). The AU technoscience and innovation strategy is a political stratagem that shows contradictions with Nkrumah's vision and his ideological conception of Africa's development. STISA-2024 lacks the historical key insights of sovereignty and decolonization that is crucial for a Pan-African modern imaginary of development, despite the AU claims to uphold Nkrumah's vision. Additionally, the AU excludes the majority of African people from its process and primarily supports the interests of the African elites and global corporations. Its STISA-2024 relies on international development funding and foreign capital. It leaves out crucial details necessary for strategic planning and effective policy development, especially as it relates to some of the fastest growing areas of emerging technology in the continent (McCarthy, 2015).

7.2.2. The Relational Imaginary of Development

In the previous section, I analyzed the technoscience and innovation strategy put forward by the AU. I showed that this strategy is underpinned by an emerging Pan-African imaginary influenced by discourses of globalization and modernist ideals of technoscientific and economic progress. In this section, I discuss a different imaginary of Pan-African development mobilized by members of civil society initiatives working on AI projects. The insights I discuss are drawn from the visions and ideas they articulated in the interviews I conducted with them. These interlocutors are researchers, practitioners, and policy analysts working on AI projects aimed at addressing challenges such as building NLP models for African indigenous languages, education and health equity, and low-resource computing with the goal of increasing access to the required infrastructure for developing AI solutions in the continent. I discuss their visions for Pan-African AI innovation not only to show the difference in their vision of African development but also as a way to think through an alternative approach for AI governance in the continent. This approach can remain faithful to Pan-African visions of decolonization and sovereignty in post-colonial Africa. It also invites the reimagination of multiple worlds and modernities (Eisenstadt, 2000), that is the core of African humanism (Dauda, 2017). This imaginary is different in the sense that it attempts to anchor its visions and ideas on African knowledge production practices and ways of knowing and being in the world while asserting technological sovereignty over AI development in the continent (Couture & Toupin, 2019).

A starting point for this imaginary is to think through what it means to have inclusive development, particularly in the context of AI considering that Africa is still largely dependent on commodity exports and development assistance, according to the latest UN report on economic development in Africa (United Nations, 2022). A prominent African AI scientist and global leader

in AI ethics articulated a different vision and ideas of what a Pan-African AI strategy might look like given the current economic structure and political climate in the continent and their intersection with global struggles around inequality. This interlocutor started a new not-for-profit organization focusing on developing AI for low-resource computing settings.

> This Pan-African AI strategy? [….]. I mean, it's like Africa is really not at the table on many of these conversations. My issue is that many of the governments are problematic, they're not representing the people. So, you know, if I would like to see a Pan-African AI strategy, what would that be? How to protect people's data, how to protect against exploitation, like, for instance, how to protect a lot of times against companies, because other countries have stronger data privacy laws, and they would like to experiment in African countries before they deploy some of their models. So, protecting against that. (Interviewee #07)

This interlocutor continued to highlight many aspects of what a Pan-African AI strategy should account for, and how AI innovation should be approached in the continent. This includes the need for AI strategy to account for making sure it prioritizes people at the margins when they're working on AI. One issue in this area specially for people in the Global South is the need for AI strategies to account for how it will transition people into the digital economy. This is especially important with the majority of the population in Africa living in rural areas, and largely peasantry (The World Bank, 2021). Another issue is the exploitation of invisible human labour involved in data practices to support AI models, as highlighted by many scholars (Crawford, 2021; D'Ignazio & Klein, 2020; Gray & Suri, 2019).

> Now, how is the AI strategy is going to play into that? Right? Is the plan to support their work? Is the plan to support their transition to other parts of the economy from an agrarian society? Or is the plan to create like a food delivery system like, you know, in Arby's, right, that mimics like Doordash, or whatever, that's what I see is the ladder. What I see is there is an elite group of people who live in the city who want to do start-ups, and they want to replicate sort of what's going on in the US or other places. That's not really touching most of the population. (Interviewee #07)

Many of the innovations that are supported by international development funding opportunities in the continent are centred around imitating the West. There have been different controversies as a response to this issue in the continent. For example, many local AI advocates contend that AI development is a new form of imperial domination and digital colonialism by Western multinational corporations. The goal is to increase capital accumulation and wealth concentration within big tech and corporate monopolies (Birhane, 2020; Kwet, 2018; Madianou, 2019). They argue that the growth in the tech start-ups ecosystem might not be aligned with the local priorities or offer leapfrogging ideas but simply copying the advanced economies in the Western world. Another important issue that intersects with AI development is the weak or lack of regulatory systems in Africa when it comes to data protection. Like many interlocutors that I interviewed, one of the AI researchers and policy analysts in Kenya looks at the issue of data as a matter of human rights. This interlocutor works for a local policy think-tank focusing on sustainable development in Africa.

> You see, we the world is quickly moving towards digital economy. And what that means is data, it is actually more valuable than even money. So, with that in mind, what does that mean? It means that, the rights of a human being must be protected within that economic system. So this the same way we have the universal human rights framework, determined by its charter within the UN, the same way we need to have an AI framework for especially the safeguards of privacy, when you talk about data privacy, data confidentiality, and data integrity, so my sentiment is to have a universal Data Protection Act, not just, you know, having one in Europe, or one in North America, but one that the world has already agreed on (Interviewee #34)

Data sovereignty has become one of the critical issues for developing AI solutions provided the cultural diversity in regulatory approaches in the continent (Makulilo, 2015, 2016; Namara et al., 2018; Prinsloo & Kaliisa, 2022). More specifically, the Collaboration on International ICT Policy for East and Southern Africa (CIPESA) highlights the lack of data protection in regulatory

frameworks, laws and policies in more than half of the African countries, sounding an alarming observation regarding the facilitation of surveillance practices by foreign actors, biometric data collection, and restrictions on encryption technologies (Nanfuka, 2022). Data protection as a human right issue may be an interesting proposal, provided that the right to privacy is a fundamental human right. This right is recognized in the UN Declaration of Human Rights and other binding international agreements and regional treaties on civil and political rights (United Nations, 1948). However, the articulation of this issue by civil society actors suggests that the data issue intersects with technoscience and innovation in Africa at the confluence of political struggles and social movements in the continent.

> For instance, there's a lot of excitement on mobile finance, right? Mobile Money, meanwhile, a lot of people are gathering data, So I think it's still extremely important to keep people's privacy, especially, you know, there are a lot of social movements in the African continent against a lot of different things. [….] when people are persecuted, it's very, very important. It's definitely in our culture, when you have revolutions, and you have all sorts of things people are organizing, and they're doing it in secret. (Interviewee #07)

The controversies surrounding the development of AI facial recognition technology by a Chinese tech company for the Zimbabwean government (Chimhangwa, 2020; Chutel, 2018; Gallagher, 2019) is an illustrative example of both privacy issues and struggles over technological sovereignty. The stated aim given by the tech company is to improve its technology for facial recognition of people with dark skin. However, this is carried out using citizens' data provided by the Zimbabwean government. Activists fear that this type of development will encourage more companies to use Africa as a laboratory for developing AI models as well as an oppressive tool by already problematic African governments. On the other hand, Calzati (2022) points out that ICT has become a critical sector of China–Africa relations amid the new scramble for Africa harnessing

Africa's data for the Fourth Industrial Revolution (4IR) that I discussed before (see section 6.2). Calzati's (2022) analysis of the case of the involvement of the Chinese tech giant Huawei in Kenya's ICT infrastructure shows that Pan-African and bilateral agreements with foreign actors, usually framed as technological innovations, continue to be at high level of abstraction and facilitate data colonialism (Couldry & Mejias, 2019). In this case, he argues that Huawei's arrangement has left local Kenyan actors effectively disempowered regarding the use of their own data for 4IR applications including those driven by AI and big data, raising concerns of data sovereignty. These agreements are typically negotiated at the Forum on China-Africa Cooperation[20] (FOCAC), a Pan-African forum for facilitation of economic and social development cooperation between China and Africa. An AI researcher and university lecturer in Kenya tried to connect ideas of Pan-Africanism in AI to issues of governance and control over local innovation.

> With Pan-Africanism for AI is coming, we don't have to go outside, we can build solutions here, and grow them and be able to have very great minds. […..] So, I believe it's really important for us Africans, to also be able to govern our own models. Governance is another key issue. We have had very good scientists come up with very good solutions, but the moment they go out there, they lose control of those solutions. (Interviewee #38)

This interlocutor is referring to African scientists and practitioners working for multinational corporations on AI projects on the continent. There are many facets to technological sovereignty as explained by Couture & Toupin (2019). For example, an AI researcher and practitioner highlighted the issue of control over technology as well as exclusionary and omission practices within the global scientific and research communities. This interlocutor is building an

20 http://www.focac.org/eng/

AI solution to increase access to education, and particularly STEM education, delivered in multiple languages including African indigenous languages in Ghana.

> So, I mean, there are a lot of Africans doing a lot of cool stuff. Why not actually present it in Africa? […….] you know, Africans in different parts of the world, their contributions are not recorded as African [……], it's interesting that always Africa is missing. (Interviewee #18)

An example that shows the complexity and entanglement of issues of data sovereignty in the continent is the situation faced by a Ghanian start-up developing free NLP models for Indigenous languages. This start-up must pay licensing fees to a private Ivy League university to use their data set of *Twi*, also known as Akan, a major indigenous language of the Akan people and spoken by most of the population in Ghana.

> As I mentioned before, like, say some agency from Germany wants to find work in African languages. We have to be careful about that. Because if and I'll make one example, there is some very large data sets. In Twi, that's available at *UPenn*. But it's like it's very expensive. And they own the rights. Okay, will you understand, so they own the rights to our language. […] we are trying to build something for our language, we have to pay them to do it. That makes no sense to me. We are the owners of the culture; we should own it. (Interviewee #37|)

In my research, I found that UPenn has a Linguistic Data Consortium[21] (LDC) where they are doing research in collaboration with international development organizations, industry, and local groups on preserving Indigenous languages around the world. This includes *Twi*, of which they have large data sets and many associated research streams in Ghana in collaboration with Kwame Nkrumah University of Science and Technology (KNUST). According to an LDC presentation by DiPersio & Cieri (2019) titled *Developing and Distributing Language*

21 https://www.ldc.upenn.edu/

Resources4All, there is a fee licensing structure by which 'data licensees contribute fees to have ongoing rights to a variety of resources', although the title might suggest otherwise. There seems to be sponsorship structure to contribute funding to 'resource creation, infrastructure, innovation, cost sharing, and resource dissemination to the community' (DiPersio & Cieri, 2019, p. 3). In the view of my researcher interlocutor from the Ghanian start-up, data sets like the *Twi* corpus should be open source and treated as a protected and shared resource of the community and part of the commons. Digital extractivism (Chagnon et al., 2022) has become a major site of controversy in both on the Global South and Global North (Couldry & Mejias, 2019; Dahlin & Fredriksson, 2017; Ricaurte, 2022; Zuboff, 2019). These practices of extracting economic value from resources perceived as common by turning them into digital property or assets (Birch & Muniesa, 2020) provoke counter-activism from social actors who see their values, rights, and livelihood threatened (Dahlin & Fredriksson, 2017). Chagnon et al. (2022) identify three types of digital extractivism including data or algorithmic extractivism, extractive digital labour such as gold farming in video games or Amazon Mechanical Turk, and cryptocurrency mining operations. This concern intersects with issues of funding and political economies of innovation, as I explained before (see section 6.2), particularly when Pan-African organizations such as the AU and local African governments seem to be lacking funding schemes for technoscience and innovation that put more emphasis on national strategies, political visions, and African sovereignty over development priorities.

> Now, the funding comes from other countries. So, that's all we have, [….], no one African governments step up and pay funds, it's all companies. Africa, you know, has so much money but they can't, you know, fund some for these issues [….] I want my son, you know, to find a lot of things and not wait for Google, Facebook and all the Western tech companies' initiatives in Africa. (Interviewee #18)

For many of the interlocutors, these issues are a result of lack of ownership over creating strategies and developing visions by Africans in the continent. There has been an increase in the number of multinational consultancies coming into the continent to ignite visions and ideas of Pan-Africanism in AI. They are often hired by institutions such as the AU and other organizations and governments advising them on how to go about the implementation of Pan-African AI strategies. The SMART Africa initiative I discussed earlier is an illustrative example of that.

> I'm not refusing, it's going to help us to have a Pan-African thing that belongs to us. But then, is it really African, when we are hiring experts from the US and the UK to lead it?! So, I think there's quite a lot of questions that we can ask beyond that. [……] The irony is, experts are hired from the US and the UK to actually come and lead those projects in Africa. (Interviewee #36)

The practice of foreign consultancy in development is one of the major issues in the continent. These practices very often are attached to the configurations of these programs as mandated by donor countries and organizations. Abegunrin (2009) argues that these kinds of consultancy practice have been an issue of concern for African countries who are indebted to financial institutions such as the World Bank and the International Monetary Fund (IMF) and others. These debts are largely expanded on foreign consultants for projects financed by these institutions (Abegunrin, 2009, p. 194). Historically, most development projects in Africa related to technoscience and innovation (ICTD area as an example) have been conceived, designed, and funded by Western international development organizations and entities. Recently, there has been a noticeable involvement by multinational corporations including big tech. However, it's important to contextualize this in a backdrop of the current shift in development discourse towards development ownership. As I discussed before (see section 6.2.1), this approach is criticized by many development studies scholars as being superficially applied in practice and resulting in

reinforcing the colonial legacy in the Global South (Harper-Shipman, 2019; Overton, 2019). However, these examples show that the shift towards local ownership needs to be examined at the confluence of the coloniality of power (Quijano, 2000) and the desire for grounding social and economic development on ideas and visions of technoscience and innovations on the local context, considering the asymmetries in global technoscientific innovation.

The discourses and practices of Pan-African AI governance discussed in this section need to be situated within the political visions of AI and national debates about what it means to build a sovereign modern African state in times of increased globalization of technological innovation.

> I mean, our people talk about Afrofuturism. Like people talk about technology that's imagined by black people. So having a re-imagination of what the role of technology is in society. But again, you know, it's really context dependent, right. I think there should be a re-imagination of what AI means in the African context. What is the point? Like, how do you want to use it? What is the goal? (Interviewee #07)

For example, this quote suggests the need for an alternative vision to go about a Pan-African AI that is based on African conceptions of the future in the continent. Based on the previous discussion, one conception of this modern Pan-Africanism, is the embeddedness of Pan-African technoscience and innovation in the struggles of today. This includes democratization processes, workers' struggles, oppressive social structures, economic exploitation, and ultimately global anti-imperialist movement (Eze, 2013). The goal is to offer Pan-Africanism as humanism, a modern project that is grounded on universal humanism (Dauda, 2017).

> We have to prove that greatness is not to be measured in stockpiles of atom bombs. I believed strongly and sincerely that with the deep-rooted wisdom and dignity, the innate respect for human lives, and the intense humanity that is our heritage, the African race, united under one federal government, will emerge not as just another world bloc to flaunt its wealth and strength, but as a Great Power whose greatness is indestructible because it is built not on fear, envy and suspicion, nor won at the expense

> of others, but founded on hope, trust, and friendship and directed to the good of all mankind. (Nkrumah, 1961, pp. xi–xiv)

The relational imaginary of modern discourse of Pan-Africanism attempts to take a critical view on the globalization of technoscience and innovation in the continent. It asks the question of what it means to be human in the 21st century and try to tackle the African context in AI from that perspective. However, this discourse can be characterized by the desire to move away from being fixated in the historical moment of Pan-Africanism as a rejection of Western paradigms of knowledge production. It uses the authority of history as a catalyst for an evolving socio-political and cultural experiences to build a more racially inclusive world. This discourse recognizes cultural differences and the diversity of human experiences, while advocating for an empirical and normative understanding of Africanity (Eze, 2013). The relational imaginary asserts that Africa's future does not and certainly must not lie in blindly mimicking foreign visions and practices of economic development and progress. It advocates for African futures that are grounded on modern Pan-African thinking of technoscience and innovation and based on ideas of universal humanism that is the core of the African tradition (Dauda, 2017).

7.3. AI as a State-building Experiment

In the previous section, I examined AI governance in Africa through the analytical lens of the Black technoscientific discourses of modernity to answer the research question of *what are the AI governance issues in Africa?* I provided descriptive and critical accounts of these governance issues by comparing two emerging Pan-African imaginaries of AI development in the continent. In this section, I provide more of a normative answer to the second part of the research question of *how should AI governance be approached in the continent?* Considering the previous debates

and controversies highlighted throughout this chapter, I argue that one way of understanding AI in Africa that can help us refine our understanding of its social, political, and economic implications in the continent is to understand AI development as a state-building experiment in post-colonial Africa. State-building and technoscience have always been intertwined processes in the continent (Elliott & Koech, 2018).

I would like to start this discussion with a question raised by a participant in the workshop for Responsible AI and Machine Learning (ML) in Africa organized by ACTS as part of Prof. CJ seminar series. The question was whether it is s too early to worry about AI ethics and instead should the focus be on AI innovation in Africa instead. On the surface, the question implies that the AI ethics debate in Africa is putting the cart before the horse. However, this question has deeper and more profound implications. The question implies normative assumption about what progress means in terms of being fixated on technological advancement. The responses in the workshop were varied and divided across the line, but one thing that was clear to me is that there is a tension between AI governance and innovation in Africa.

One of the sources for this tension is the foregrounded model of innovation itself that ignores critical questions such as what it really means to innovate in the African context. One of the workshop participants emphasized the fact that Africans need to ask themselves why they need AI and what work AI does in Africa. A contrary point raised as a response by the chair of the workshop. After acknowledging the importance of AI ethics, the chair stressed the urgency that Africans need to recognize that 'the train has left the station' (Field Notes, June 14, 2022). This point was reinforced by one of the lead organizers of the workshop.

> There's no doubt that AI will bring economic prosperity to the continent, and we must be careful as researchers not to scare policy makers away from supporting AI, the ethical debate might to be positioned in a way that might make them fear the

> technology. There are already fears in the continent in terms of job losses due to AI automation. (Field Notes, June 14, 2022)

I checked some of the recent stats on industrial jobs in the continent. Industrial jobs in Africa represents less than 15% of the total employment in the continent, according to Statista (2022). This brought several questions to mind, trying to understand what was at stake in these debates from the African perspective.

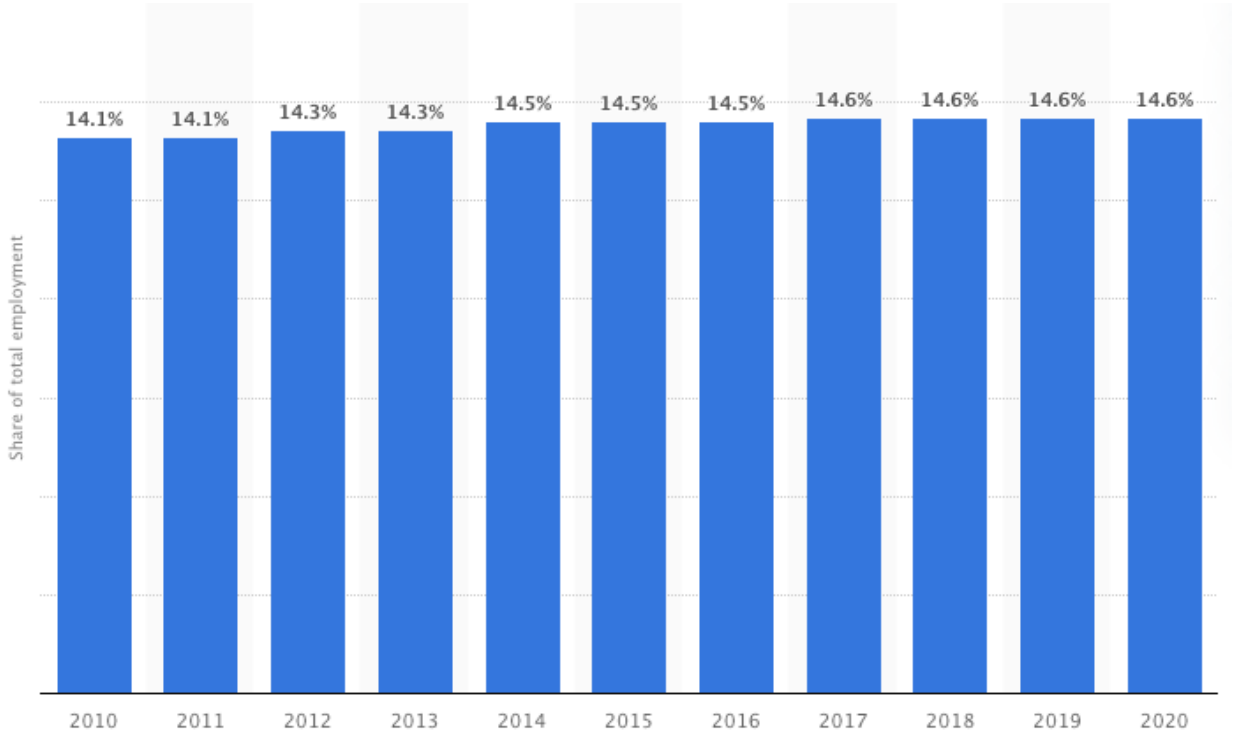

Figure 5: Employment in the industry sector in Africa 2010-2020
(Statista, 2022)

The tension between how these numbers may be interpreted and the controversies over the risks and benefits of AI automation, suggests that there is a need to consider the political dimensions underpinning the visions of AI innovation in Africa to understand what is at stake in

these debates. From a politics of technology perspective, what seems to be overlooked in the AI4D and the larger ICT4D is an understanding of development as a state-building project in post-colonial Africa. Bonneuil (2000) argues that development regimes were established by former colonial power as a way of managing the African environment and generating knowledge about African societies. However, Western development ideologies and practices played an import role in the construction of the African state and ironically they fuelled at later stages the interest of colonial power in the values of Indigenous knowledge. Krige & Wang (2015) argue that the relation between technoscience and nation building were laid down by knowledge that was mobilized and adapted to local conditions by established power structures. However, they point out that opposition and resistance to the imposed knowledge and values drew from local knowledge to construct alternative visions of the future. Krige & Wang (2015) argue that knowledge was essential to the performance of power in nation building, and the fashioning of legitimate and legitimizing certain visions of the future. On the other hand, Elliott & Koech (2018) show that political power and geopolitics with its accompanying political violence played a significant role on the construction of technoscience infrastructure necessary for building the modern African state in the post-independence era.

As discussed in the previous sections and conceptualized in the theoretical chapter (see sections 3.2 and 3.4), historically decolonization and state-building were two inextricably linked processes in Africa. The decolonization project was conceived post-independence of African states and sought to completely dismantle the colonial structures and institutions as well as the ideas of Western modernity. The aim was to rebuild national institutions and local social and economic structures that are based on African values, cultures, languages and so forth. For example, in many African countries, the post-independence struggle for incorporating local indigenous languages

into the local education system symbolized this process of decolonization. However, in the context of modernization and the global shifts towards contemporary modes of capitalist production such as the model of the 4IR, AI4D development projects are not just about AI and innovation but they are equally about state-building and the political imaginations of Africans about the future in the continent. From a theoretical view, this development can be approached from a sociotechnical imaginaries perspective, as discussed in the theoretical chapter (ibid) and chapter five (see section 5.5). Jasanoff & Kim (2009) outline the most durable features of sociotechnical imaginaries including the framing of risks, defining policy focus, crystallizing the stakes behind policies, debating social and technical controversies, establishing avenues and means of closure, and rationalizing policy through national civic epistemologies (p. 139). In the following, I outline these dimensions and their connections to state-building based on the discussion in this section and from my examination of the case of AI development in Africa.

An African AI scientist put a normative stance on AI development in the Africa and its relation to future development in the continent, highlighting some of the stakes in this normative vision. This interlocutor is working on several AI initiatives across several African countries including AI4D in Africa.

> So, the fourth industrial revolution is driven by artificial intelligence and Internet of Things. And I think everybody in the continent will have this […] people are just getting used to this […] we try to emphasize that we do not want the continent to be left out in this revolution, which includes everything is driven by integrating artificial intelligence. We want to ensure that yes, even if Africa is going to follow with other people, it should be on an ethical way. Interviewee #06

Indeed, the fear of falling behind is a major contributor to the anxiety on the part of the advocate of AI technology in the continent. However, underneath these debates and controversies are the salient issues of global inequalities. Discourses of AI development in Africa are shaped by

narratives, and lived experiences of inequality and development disparities that long dominated the debates about the role of ICT in propelling the continent forward (Powell, 2001; Unwin & Unwin, 2009). Inequality in the Global South, and particularly Africa has been the battle ground for technology transfer over the years (Ojo, 2018; Powell, 2001). However, one of the different characteristics of inequality discourse in the case of AI development, is a tendency to go beyond issues of the digital divide that dominated ICT4D discourse (Parayil, 2005). Instead, there is a shift more towards ideas of increased participation in the basic research and innovation practices of AI technology locally and globally. Programs such as AI4D Africa, and the tech innovation hubs in the continent, discussed previously (see section 6.2), have become sites of controversies about global and local inequalities in the continent. The risks are framed in the context of an Africa that continues to be perceived as falling behind or always up for grab by processes of appropriation and exploitation. Many actors see that the stakes in the local development of AI are concerning responsible AI and inclusive development. While, on the other hand, proponents of local AI innovation practices are pushing for technological sovereignty and putting forward ideas based on African indigenous knowledge to challenge Western rationales of progress and economic development. State and non-state actors have deployed civic epistemologies to bring closure to these debates such as the modernization of traditional sectors and nationalizing sustainable development goals like the "Africa We Want" as articulated by the AU Agenda 2063. The main policy focus in these efforts is around local capacity building in the continent, as illustrated earlier in this chapter.

However, as evident by the discussion of the AU technoscience and innovation strategy in this chapter, there is a lot of skepticism regarding the political institutions in the continent. For example, as shown in the previous discussions, there are doubts about whether the AU has the

capacity or equipped to deliver on the objectives laid out in its strategy. Such ideas of Pan-African technoscience and innovation require the political infrastructure to support it. A policy analyst working for the National Center for Technology Management, a governmental agency under the Federal Ministry of Science and Technology in Nigeria expressed this sentiment.

> Africa, unfortunately, does much work without work. For the Pan-African integration program to get proper implementation, there are things to do like having a route from West Africa to North Africa, but we will not be able to do that. The construction has been ongoing for long. So, the issue here is that the Pan African issues have always been there and so their strategies. There has been much talk, but we have yet to walk the talk. Africa won't achieve integration until they are able to achieve a stronger form of strategies, especially as it relates to science, technology, and innovation. (Interviewee #05)

This interlocutor argued that the main reason for such failures is because 'both Anglophone and Francophone Africans still rely on Britain and France for most of the thinking. They bring them to impose upon Africa programs that don't work' (Interviewee #05). Abegunrin (2009) argues that Africa does not need a half-hearted and half-measured organization. He points out that what the AU needs to do is 'mental decolonization, self-reliance, and self-transformation' to end its dependence on others and develop the ability to create new strategies to solve their own problems. He stressed the need for African states to develop innovative homegrown strategies and not rely on obtaining international support. Abegunrin (2009) argues that in fact by doing so 'Africa's case for international collaboration and assistance becomes both credible and achievable if Africans are spearheading such efforts' (Abegunrin, 2009, pp. 197–198). An AI from Africa including governance of technoscience, and innovation needs institutional building more than anything. African nation states need to show the required political commitment not only for funding local AI innovations but also for building democratic institutions. These institutions should be capable of bringing the multiplicity of visions of the citizens and the different AI

communities to influence the kinds of policies and governance frameworks that are required to have an African AI project. This AI project needs to engage seriously with issues of social justice in the continent at the centre of technology policy discourse.

7.4. Conclusion

In this chapter, I have illustrated the need to engage with the political ideas and imaginations of the different AI communities in Africa about their visions of the future in the continent to understand AI governance issues in Africa. I illustrated that AI controversies in the continent are entangled with different visions of modernization and development that seek to end Africa's long-standing economic and social problems. I argued that looking through the analytical lens of the Black technoscientific discourses of modernity into the AI debates in the continent, allows us to situate these controversies within the larger national debates about state-building in Africa. It allows us to bring the different contested visions of a modern African state and to what degree processes of globalization are shaping these conceptions. I described two Pan-African imaginaries of technoscience and innovation that underpin AI debates about state-building in Africa. The first one is a rational imaginary advocating for a modern state that is globally integrated and aspires to the ideals of economic development of the advanced economies in the Global North. The rational imaginary looks at AI development with less critical and more normative view on the social implications of AI technology putting forward technoscience and economic development rationales. The second imaginary is a relational imaginary advocating for a vision of a modern sovereign African state, reminiscent of the decolonial project post-independence in Africa and its ideals of Pan-Africanism. The relational imaginary seeks more agency for the local actors and technological sovereignty while being critical of the absent role of

the state as a sovereign entity and the involvement of multinational corporations and international development agencies.

In attending more closely to the question of how to approach AI governance in Africa, I argued that AI researchers, practitioners and policymakers need to resist normative and instrumental views of how AI should fit into the African context. Instead, they need to consider the political cultures that infuse certain visions of AI in Africa. Technoscience and innovation could have a significant positive contribution to Africa's socioeconomic development objectives. However, it needs to have a solid theoretical underpinning and be grounded on empirical evidence from the continent rather than normative claims drawn from Western experiences, capitalist models of commercial success, and universalist philosophies of technoscience and innovation. This requires serious engagement with the local political communities to activate their imaginations and begin to ask serious questions about what kind of futures and social orders that Africans desire out of AI. State-building as a post-colonial project in Africa continues to be an unfinished project. However, technological advancements such as AI are opening-up different ways not to only think about the materiality of AI but also about how AI is reshaping the historical debates about development and modernization in the continent.

8. Conclusion

In this dissertation, I conducted an empirical investigation into the case of AI in Africa where AI technoscientific innovation is framed as a pathway to development, progress, and modernization in the continent. I looked at this object through the analytical lens of the Black technoscientific discourses of modernity. The analysis of this research revealed different discourses, contested visions, and sociotechnical imaginaries articulated by different social actors in the co-production of AI and society in Africa. From this perspective, decolonizing AI, the lack of African context in AI, the roles of the state and international development in technoscientific innovation, Pan-Africanism and state-building in post-independence Africa emerged as important discussion points in this dissertation. In this final chapter, I first summarize this investigation and recap the discussion and work done. I then highlight the key empirical findings in relation to my research questions and objectives. I also discuss the theoretical contribution of this dissertation and outline its implication and possible future research direction. Finally, I conclude this dissertation with a general discussion on decolonization, the global politics of knowledge and what this means for African technology policy in a modern neocolonial world system.

8.1. Summary

In broader terms, this research focused on the development of AI across several African countries (Kenya, Ghana, Nigeria) in a couple of areas including AI for development and AI in commercial settings. The main issue at stake in this project is the governance of AI technoscientific innovation and sociotechnical practices in the continent.

In the literature review chapter (two), I looked at literature from science and technology studies including co-production, sociotechnical imaginaries, and the political economy of

technoscience. I also reviewed the literature in other two areas including anti-colonial computing and AI in Africa. This literature review revealed that most of the literature surrounding technoscience lacks the understanding of the social, economic, and political specificities of technoscience formations in the Global South, and particularly Africa. I also argued that, as scarce as it is, the existing literature on AI technoscientific innovation in Africa seems to be taking a universalist approach based on Western epistemologies and normative understandings of the implications of technoscience in Africa. The literature review also showed that most of the research on AI is oriented towards Euro-American centric perspectives. It lacks the geographic specificity to Africa. In addition, it relies on Western normative and instrumental understandings of the risks and benefits of AI in the Global South, and particularly Africa.

In the theoretical chapter (three), I developed the theoretical framework of the *Black technoscientific discourses of modernity* which looks at the articulations and practices of AI in the margins as a form of co-production of technoscience and society that foregrounds sociotechnical imaginaries of African modernity. I showed the need for an epistemic reorientation and different theoretical approach to examine contemporary technoscience and innovation phenomena in Africa. I argued that this epistemic reorientation rests on destabilizing familiar categories such as race, Blackness, Global South-Global North, science, technology, and innovation among others. This approach foregrounded critiques of knowledge production practices in technoscientific capitalism. I argued that the generative capacity of the Black technoscientific discourses of modernity helps us see encounters with technoscience and innovation in the margins as forms of creative articulations of alternative modernities.

In the methods chapter (four), I outlined my methodological and analytical approaches in working with the two empirical case studies about AI development in the continent. I conducted

multi-sited ethnographic case studies (Fusch et al., 2017; Hiruy, 2014; Ó Riain, 2009; Schwandt & Gates, 2018). I used three techniques for the building of my corpus including interviews, participant observations, and document analysis. I also reflected on my field work highlighting politics and power dynamics that I encountered. I turned to feminist standpoint theory and feminist and Black feminist thinkers (Collins, 2008; Harding, 1991; Smith, 1993) to resolve tensions risen in the field.

In the empirical analysis chapters (five, six, seven), I looked at three aspects of this project including decoloniality, the political economy, and governance of AI. In chapter five, I traced the genealogies of decolonization in African by looking at the histories of Pan-Africanism and African socialism. I also showed different emerging conceptions of decolonizing AI in Africa. I argued that these emerging conceptions foreground an understanding of decolonizing AI as a sociotechnical imaginary. The discussion in chapter five addressed different aspects of decolonization as it relates to AI. First, I critiqued the notion of universality in AI ethics. Second, I problematized current decolonial approaches to AI ethics as they reproduce similar binaries that decoloniality is set to challenge (Ortega, 2017; Wood, 2020). They also lack the adequate engagement with the political imaginations of the globally marginalized AI epistemic communities they are trying to influence.

In chapter six, I looked at AI innovation in Africa and mapped out the contours of its political economy. I showed that this development focuses on capacity building to tackle both technoscientific research and applied AI for commercial applications. I also showed that the underlying driver for this development is the global push for sustainable development and the fourth industrial revolution.

In chapter seven, I focused on AI governance and discussed the different contested visions of AI governance in the continent. I showed that these controversies foreground different models of modernization and development in Africa. To illustrate these visions, I examined the African Union's strategy for science, technology, and innovation in contrast to other discourses articulated by my interlocutors about their visions of AI governance. I showed that what at stake in these visions is the unfinished project of state-building in post-colonial Africa.

8.2. Key Empirical Findings

After I summarized the work done in this dissertation, I turn my focus to the key findings stemming out of the research questions outlined in the methods chapter. These research questions were formulated around three concerns for this project, namely, knowledge production, political economy, and governance of AI in Africa.

8.2.1. Transformative Adaptation: A Process of Bottom-up Decolonization

In answering the first question, *how is AI development reconfiguring the debate about development, progress, and modernization in Africa?* I traced the trajectories of decolonization and Pan-Africanism, as mutually constitutive intellectual ideas, with profound implications for shaping this debate in the continent. I revealed different conceptions of decolonizing AI articulated by different social actors. These conceptions apprehend certain practices of transformative adaptation of the AI technology to the local context as a decolonial practice. I argued that conceptions of transformative adaptation constitute particular forms of co-production in the margins. However, they are underpinned by certain decolonial ambivalence towards questions of power, politics, and knowledge. I argued that this form of ambivalence stems from an inherent

tension in the notion of the mutability of modernity. This can be demonstrated by the current debates in AI ethics surrounding universality and decoloniality. From this perspective, I argued that one way of resolving this tension is by looking at decolonizing AI as sociotechnical imaginary.

8.2.2. The Deficit Logic of Responsible AI: The Lack of African Context in AI

In examining the second question, *how is the AI innovation ecosystem configured in Africa and what are the implications for local sociotechnical practices of AI innovation?* I showed that the AI innovation environment in the continent is configured by practices of international development, social responsibility of multinational corporations, and philanthropy. I argued that this configuration operates within an international framework that seeks to globalize AI technoscientific innovation. This global agenda is built around the development of responsible AI and relies on a deficit logic that frames the lack of African perspectives in AI as the major barrier for AI diffusion and for AI to address the socioeconomic issues in the continent. Despite the framing of responsible innovation (Ortt et al., 2020; Owen et al., 2013; Woot, 2017) around inclusion and social justice, the built-in deficit logic facilitates the exclusion of globally marginalized epistemic communities from AI innovation. This logic denies these communities their participation out of the gate by subjecting them to fragmented processes of catching up. I showed how this logic operates within the AI environment in the continent through articulations of the lack of African context in AI as deficits in African data sets and African innovation.

8.2.3. AI Governance: Political Imaginaries of Contested Futures

In investigating the third question, *what are the AI governance issues in Africa and how should AI governance be approached in the continent?* Two imaginaries emerged out of this

inquiry representing two contrasting visions of Pan-African AI project and state-building. One imaginary operates within the framework of globalization and makes normative claims about the impact of technoscience while foregrounding visions of economic development and technoscientific innovation. This imaginary appeals to modernist ideals of technoscientific capitalism. The other one operates within a framework of technological sovereignty and reclaiming of the development agenda in Africa. It makes claims to African ways of knowing and being in the world. From this perspective, I argued that a more productive approach to think about AI governance in the continent is to look at AI development as a state-building project in postcolonial Africa. In this sense, there is a need for the rebuilding of institutional infrastructures in Africa that can support national strategies of technoscientific innovation in AI. This requires more engagement with the different political imaginaries of the different local AI communities about their ideas and visions for AI development in the continent.

8.3. Key Theoretical Contributions

This dissertation broadens the theoretical and analytical perspectives of science and technology studies (STS) (Birch, 2013; Jasanoff, 2004; Jasanoff & Kim, 2015) through crosspollination with contemporary African studies (Mbembe, 2017; Ndlovu-Gatsheni, 2018; Ngũgĩ wa Thiong'o, 2009). At the same time, it extends African studies inquiry into the realm of AI. A main contribution of this dissertation has been to take up the insights afforded by contemporary African studies scholars and apply them to the study of technoscience and innovation in the continent. In this section, I outline three interrelated contributions in relation to the theoretical perspectives that I referenced in the previous chapters including the sociotechnical imaginaries, decoloniality, and African modernity.

8.3.1. Opening the Fields of the Imaginaries and Political Economy of AI in Africa

By bringing in perspectives from African studies, I illuminated the relation between race, technoscience, coloniality, and modernity in the creation of imaginaries (Mbembe, 2021). I examined processes of exclusion in the imaginations and political economies of AI in the continent. I highlighted the racialized social structures of the epistemic communities engaged in technoscience and innovation globally. This analysis shows the practices of exclusion and marginalization of local social actors from the creation of dominant sociotechnical imaginaries. On the other hand, I showed that in response, these local actors engage in co-production practices and foreground sociotechnical imaginaries of alternative modernities. I showed that these imaginaries are influenced by histories of colonialism and economic exploitation in the continent, decolonial imaginations, and particular African technoscientific visions of modernity.

By doing so, I extended the sociotechnical imaginaries framework beyond the focus on descriptive cultural analysis of co-production (Tyfield, 2012). I incorporated the neglected aspect of the political economy of technoscience in influencing imaginaries by examining the economic environment in which technoscience innovation emerges in Africa. The examination of AI innovation in Africa demonstrated the role of the international development community in sustaining dominant sociotechnical imaginaries in the local context. I showed that the political economy of AI in Africa allows these international actors to influence the co-production of African technoscience and society. The framing of the development of AI in the continent in terms of responsible innovation provides the international community with the legitimacy to influence the configuration of society and technoscience in the local context. I showed that this conception influences how AI sociotechnical imaginaries are mobilized by local social actors. As such, local discourses of responsible AI drew on the lack of African context in AI as the major obstacle for

AI to address the social and economic issues in the continent. This extends the scope of the imaginaries beyond the national to incorporate how global sociotechnical imaginaries influence the local imaginaries. This also gestures towards processes of exclusion and marginalization in the creation of dominant imaginations of technoscience and innovation.

8.3.2. Shifting the Discourse of Decolonizing AI

This research advances decoloniality in AI in the context of Africa. As I drew on decolonial thinking and African studies scholarship to extend the sociotechnical imaginaries, I contributed to decolonial theory by highlighting the role of imaginaries in the decolonization processes. One of these contributions is the incorporation of co-production (Jasanoff, 2004) into decoloniality. Tuck & Yang (2012) point out the need for the decolonization discourse to decentre the narratives by which colonial power romanticizes Indigenous knowledge and casts its own futures in the former colonies. Instead decoloniality needs to deconstruct the colonial structures that continue to oppress the former colonies and fashion its own conceptions of the future. This requires the decolonizing AI discourse in the continent to seriously engage with the political imaginations of the different AI communities about their visions of the future in Africa.

By incorporating social actors that challenge dominant discourses of decolonization in the continent, I put forward decolonization as an idea open for political contestation and mutual stabilizing and destabilizing by society in the continent. The historical context of decolonization and Pan-Africanism asserts this political dimension in the debate over decolonization in Africa and the diaspora. This research examined how the understanding of AI technology impacts the visions of these actors about the future in Africa, and in return how these visions shape the development of AI technology in the continent. By showing how decolonizing AI can be

approached from the perspective of transformative adaptation as articulated by these actors, I pointed out to processes of co-production of African futures and technoscience in the margin. From this perspective, I argued for the understanding of decolonizing AI as a sociotechnical imaginary in African modernity. This understanding of AI development as an imaginary can help us refine our understanding of the social, economic, and political impact of technoscience and innovation in Africa. It asserts the importance of the role of political culture in the imaginations of technoscientific futures. Moreover, it moves the decolonization discourse away from dichotomous narratives and binary depictions of the implications of technoscience and innovation that decoloniality sought to disrupt. This understanding enables us to offer more generative ways of thinking about the messy realities of technology transfer and innovation diffusion in the Global South. If decolonial scholars are pursuing epistemic decolonization, they should attend more closely to the co-production processes taking place in the communities they are trying to decolonize.

8.3.3. Moving Theory South: Modern Discourses of Technoscience in Africa

A major concern for this dissertation was to find more productive and generative mode of critique in the case of AI in Africa to think about its social, political, and economic implications in the continent. The Black technoscientific discourses of modernity responds to this urgency by taking a discursive-material approach into looking at contemporary practices of technoscientific innovation in the continent. As I discussed in the theoretical chapter, this analytical approach is built on the notion of co-production (Jasanoff, 2004), critique of Black reason (Mbembe, 2017), and theory from the South (Comaroff & Comaroff, 2011). It understands the governance of contemporary technoscience and innovation in the margins as a form of co-production of

technoscience and society in alternative modernity. In this sense, this framework extends the examination of the political materialities and discursive practices of technoscience and innovation by incorporating race as one of the constitutive elements in the production of future imaginaries of particular social orders.

The understanding of decolonizing AI as a sociotechnical imaginary, the configuration of the AI innovation ecosystem around responsible AI to support sustainable development and industrialization, and the understanding of AI governance as a political project about state-building offer a holistic view that shows how emerging technologies are been debated to sustain particular visions of modernity in post-colonial Africa. This holistic view does not privilege one analytical perspective over the other. To the contrary, it encompasses an interplay of both discursive and material undercurrents.

By taking the analytical perspective of the Black technoscientific discourses of modernity, this dissertation contributes to knowledge in two directions. First, while much has been written about theorizing the social science from the South (Chakrabarty, 2007; Connell, 2007; Ndlovu-Gatsheni, 2018), however, there has not been much empirical work to look at emerging knowledge production practices in the margins, and specifically in science, technology, and innovation. Second, the literature that looks at the social and economic implications of technology in the Global South, and particularly Africa, remains concentrated in the ICT4D area including the emerging area of AI4D. As I discussed in this dissertation, this area overwhelmingly offers normative and instrumental views in the role of technoscience in development. From this perspective, the notion of the Black technoscientific discourses of modernity enhances the inquiry in this area by offering a more productive and generative accounts of AI development in the Africa.

8.4. Possibilities and Future Research Direction

A major area of concern emerged out of this project as a possible future research direction is related to data governance in Africa. As highlighted in this dissertation, data for the scientific research and the application of AI technology was a major topic of discussion. With initiatives such as the Lacuna Fund for data collection and the lack of data protection laws in the continent, there is urgency to examine this area at the intersection of the political economy and data coloniality.

The push for open data by multinational corporations and international development organizations needs to be problematized in order to ensure data justice in the continent. The research questions of this dissertation can be extended in this direction to offer an in-depth analysis of local data practices and their implications for theory and praxis. For example, this proposed research can look at how the current debate about development and modernization in Africa is reshaping the understanding of data governance in the continent. Consequently, how data governance should be approached from an African perspective.

This research agenda can look at mapping the state of data governance in Africa and evaluate existing policies to understand the gaps with respect to the fair distribution of the benefits from the collection and usage of free data. There are also theoretical aims out of this investigation. For example, the concept of data coloniality might need to be extended to fit African conceptions of decolonization. Another area is to think through how African communal practices might inform ideas such as open data and data privacy, both currently conceived with Western approaches.

8.5. Implications: Decolonization, Politics of Knowledge, and Technoscience Policy

As I argued in this dissertation, decoloniality needs to be geographically situated. I showed that historically, decolonization in Africa was grounded on political struggles in Africa and the diaspora and focused on the transfer of power from the metropolis to former colonial possessions (Mbembe, 2021; Ndlovu-Gatsheni, 2018; Ngũgĩ wa Thiong′o, 1986). It was a process of complete overthrow of the colonial structures and institutions of modernity. In this sense, decolonization signified the return to African communal ways of knowing and being in the world. It was a process of searching for Africanness in a modern, capitalist, and neocolonial world system (Ngwena, 2018; Nkrumah, 1965). From the early incarnations of Pan-African movements during the transatlantic slave trade to the contemporary struggle for African independence, the aim of decolonization in Africa has always been the restoration of African people to their proper place in history (Adi, 2018; Eze, 2013). On the other hand, after decades of African independence, this political process has not proven to be successful in dismantling colonialism in the continent. As Nkrumah (1965) argued long ago, the essence of neocolonialism is the perceived international sovereignty of the state while its economic system and political policy are directed from outside. The mechanisms by which neocolonialism operates are multilateral aid and international assistance to the former colonies.

On the other hand, over the last few decades, the field of decolonization has been transformed to encompass more than traditional questions of territorial sovereignty to include questions of epistemology and practices of knowledge production across almost all disciplines and geographies of knowledge production. Notwithstanding decades of decolonization attempts, the South continues to experience epistemic injustice (Byskov, 2021) as a second-class epistemic knower to the North in modernist social theory (Connell, 2007; Mbembe, 2021). Decolonial ideas are co-opted into Western framings of new genealogies of social justice, human rights, sustainable

development, environmental justice and so forth without adequately attending to questions of power, politics, international relation, knowledge production, and local conceptions of futurities and social orders in the post-colonies.

As this dissertation showed, technoscientific innovation in emerging technologies such as AI in Africa can be characterized by two trends. The first one is the increased involvement of social actors from international development organizations, multinational corporations, and philanthropic organization. International development practices have not proven to help low-and-middle-income countries in the Global South escape their long-standing socioeconomic situation, despite recent attempts of development ownership (Harper-Shipman, 2019; Overton, 2019). The second one is the absent role of the state from technoscience and innovation in the continent. The important role of institutional infrastructure and national investment in capacity building is well documented in the literature (Amankwah-Amoah & Lu, 2022; Barro, 1991). As I showed in this dissertation, the accounts of many of the social actors in this research emphasized the role of the state and raised concerns that the development of AI in the continent may not be responding to the needs of the local context.

Bringing these two reflections together, a major recommendation of this research is for African states to have a renewed urgency to ground current thinking on globalization in the continent in African sovereignty, both economically and politically. While this dissertation does not devise specific policy proposals as part of its research objectives. However, this research can suggest a few recommendations for how to approach the governance of technoscience and innovation in the continent. The discussion on the relational imaginary in the previous chapter highlighted the need for African governments to invest in institutional building and strengthening democratic processes to allow for the multiplicity of contested visions of ideas about the

technoscientific futures in the continent to flourish. Policymakers need to resist normative and instrumental views on the role of technoscience and innovation in the economy and society. They need to focus the policy debates on the political dimensions of technoscience innovation. Recognizing that the digital economy including that of AI innovation needs to respond to the realities of the economic environment in the continent as such there is need for more understanding of the impact of these technologies on the rural population and the rural economy. Additionally, more attention is needed to understand what this trend of the digital means for structural transformation in Africa.

9. Bibliography

Abegunrin, O. (2009). *Africa in Global Politics in the Twenty-First Century: A Pan-African Perspective*. Palgrave Macmillan.

Adam, A. (2002). Gender/Body/Machine. *Ratio*, *15*(4), 354–375. https://doi.org/10.1111/1467-9329.00197

Adam, H. (1988). Exile and resistance: The African National Congress, the South African Communist Party and the Pan Africanist Congress. In *A Future South Africa:Visions, Strategies, And Realities*. Routledge.

Adams, R. (2021). Can artificial intelligence be decolonized? *Interdisciplinary Science Reviews*, *46*(1–2), 176–197. https://doi.org/10.1080/03080188.2020.1840225

Adeoye, J., Akinshipo, A., Thomson, P., & Su, Y.-X. (2022). Artificial intelligence-based prediction for cancer-related outcomes in Africa: Status and potential refinements. *Journal of Global Health*, *12*. https://doi.org/10.7189/jogh.12.03017

Adi, H. (2018). *Pan-Africanism: A History*. Bloomsbury Academic.

Adi, H., & Sherwood, M. (2003). *Pan-African History: Political Figures from Africa and the Diaspora since 1787*. Routledge. https://doi.org/10.4324/9780203417805

Adu, P. (2019). *A Step-by-Step Guide to Qualitative Data Coding* (1st edition). Routledge.

Africa Seminar. (1967). *Africa, National and Social Revolution: Collection of Papers Read at the Cairo Seminar*. Peace and Socialism Publishers. https://www.marxists.org/subject/africa/nkrumah/1967/african-socialism-revisited.htm

African Union. (1963). *SPEECHES & STATEMENTS MADE AT THE FIRST ORGANIZATION OF AFRICAN UNITY (O.A.U) SUMMIT*. African Union. https://au.int/sites/default/files/speeches/

African Union Commission. (2014). *Science, Technology and Innovation Strategy for Africa 2024*. African Union. https://au.int/en/documents/20200625/science-technology-and-innovation-strategy-africa-2024

African Union Commission. (2015). *Agenda 2063: The Africa we want.* https://au.int/sites/default/files/documents/36204-doc-agenda2063_popular_version_en.pdf

Ahmad, A. Y., Osei-Amponsah, C., & Kebede, K. Y. (2022). Introduction to a special issue on 'Building innovation capabilities for sustainable industrialization in Africa: Status and prospects.' *Innovation and Development*, *12*(2), 177–187. https://doi.org/10.1080/2157930X.2021.1928988

Aina, T. A. (2013). The State, Politics and Philanthropy in Africa: Framing the Context'. In T. A. Aina & B. Moyo (Eds.), *Giving to Help, Helping to Give: The Context and Politics of African Philanthropy*. Amalion Publishing.

Al Dahdah, M. (2022). Between Philanthropy and Big Business: The Rise of mHealth in the Global Health Market. *Development and Change*, *53*(2), 376–395. https://doi.org/10.1111/dech.12497

Ali, M. (2014). Towards a decolonial computing. *Ambiguous Technologies: Philosophical Issues, Practical Solutions, Human Nature*, 28–35. http://oro.open.ac.uk/41372/

Ali, M. (2016). A brief introduction to decolonial computing. *XRDS: Crossroads, The ACM Magazine for Students*, *22*(4), 16–21. https://doi.org/10.1145/2930886

ALT Advisory. (2022). *AI Governance in Africa*. https://ai.altadvisory.africa/wp-content/uploads/AI-Governance-in-Africa-2022.pdf

Amankwah-Amoah, J., & Lu, Y. (2022). Harnessing AI for business development: A review of drivers and challenges in Africa. *Production Planning & Control*, *0*(0), 1–10. https://doi.org/10.1080/09537287.2022.2069049

Ananny, M. (2016). Toward an Ethics of Algorithms: Convening, Observation, Probability, and Timeliness. *Science, Technology & Human Values*, *41*(1), 93–117. https://doi.org/10.1177/0162243915606523

Anderson, B. (1983). *Imagined Communities: Reflections on the Origin and Spread of Nationalism* (Revised edition). Verso.

Anderson, W. (2002). Introduction: Postcolonial Technoscience. *Social Studies of Science*, *32*(5/6), 643–658.

Angermuller, J. (2015). Discourse Studies. In J. D. Wright (Ed.), *International Encyclopedia of the Social & Behavioral Sciences (Second Edition)* (pp. 510–515). Elsevier. https://doi.org/10.1016/B978-0-08-097086-8.03216-5

Ani, K. J., & Ojakorotu, V. (2017). Pan-Africanism, African Union and the Challenge of Transformative Development in Africa. *Journal of African Union Studies*, *6*(1), 5–23.

Appadurai, A. (2013). *The Future as Cultural Fact: Essays on the Global Condition* (1st edition). Verso.

Archibald, M. M., Ambagtsheer, R. C., Casey, M. G., & Lawless, M. (2019). Using Zoom Videoconferencing for Qualitative Data Collection: Perceptions and Experiences of Researchers and Participants. *International Journal of Qualitative Methods*, *18*, 1609406919874596. https://doi.org/10.1177/1609406919874596

Arvidsson, A., & Colleoni, E. (2012). Value in Informational Capitalism and on the Internet. *The Information Society*, *28*(3), 135–150. https://doi.org/10.1080/01972243.2012.669449

Avis, J. (2018). Socio-technical imaginary of the fourth industrial revolution and its implications for vocational education and training: A literature review. *Journal of Vocational Education & Training*, *70*(3), 337–363. https://doi.org/10.1080/13636820.2018.1498907

Azungah, T. (2018). Qualitative research: Deductive and inductive approaches to data analysis. *Qualitative Research Journal*, *18*(4), 383–400. https://doi.org/10.1108/QRJ-D-18-00035

Baker, B. (2009). CHAPTER 17: Postcolonial Technoscience, Toleration and Anti-imperialism, and Education and Psychology. *Counterpoints*, *369*, 289–308.

Ballo, I. F. (2015). Imagining energy futures: Sociotechnical imaginaries of the future Smart Grid in Norway. *Energy Research & Social Science*, *9*, 9–20. https://doi.org/10.1016/j.erss.2015.08.015

Barbehön, M., Münch, S., & Lamping, W. (2015). Problem definition and agenda-setting in critical perspective. *Handbook of Critical Policy Studies*. https://www.elgaronline.com/view/edcoll/9781783472345/9781783472345.00021.xml

Bareis, J., & Katzenbach, C. (2021). Talking AI into Being: The Narratives and Imaginaries of National AI Strategies and Their Performative Politics. *Science, Technology, & Human Values*, 01622439211030007. https://doi.org/10.1177/01622439211030007

Barkan, J. (2013). Plutocrats at Work: How Big Philanthropy Undermines Democracy. *Dissent Magazine*. https://www.dissentmagazine.org/article/plutocrats-at-work-how-big-philanthropy-undermines-democracy

Barrett, M. (1987). The Concept of "Difference." *Feminist Review*, *26*, 29–41. https://doi.org/10.2307/1394733

Barro, R. J. (1991). Economic Growth in a Cross Section of Countries. *The Quarterly Journal of Economics*, *106*(2), 407–443. https://doi.org/10.2307/2937943

Bellanova, R., Jacobsen, K. L., & Monsees, L. (2020). Taking the trouble: Science, technology and security studies. *Critical Studies on Security*, *8*(2), 87–100. https://doi.org/10.1080/21624887.2020.1839852

Bender, C. (2017). The Culture Area as Boundary Object. *Zeitschrift Für Ethnologie*, *142*(2), 265–288.

Benjamin, R. (Ed.). (2019a). *Captivating Technology: Race, Carceral Technoscience, and Liberatory Imagination in Everyday Life*. Duke University Press.

Benjamin, R. (2019b). *Race After Technology: Abolitionist Tools for the New Jim Code* (1 edition). Polity Press.

Benn, S., Edwards, M., & Angus-Leppan, T. (2013). Organizational Learning and the Sustainability Community of Practice: The Role of Boundary Objects. *Organization & Environment*, *26*(2), 184–202. https://doi.org/10.1177/1086026613489559

Bennett, M. (2016). Afrofuturism. *Computer*, *49*(4), 92–93. https://doi.org/10.1109/MC.2016.99

Benyera, E. (2021). *The Fourth Industrial Revolution and the Recolonisation of Africa: The Coloniality of Data*. Routledge. https://doi.org/10.4324/9781003157731

Berland, O. (1999). The Emergence of the Communist Perspective on the "Negro Question" in America: 1919–1931: Part One. *Science & Society*, *63*(4), 411–432.

Berland, O. (2000). The Emergence of the Communist Perspective on the "Negro Question" in America: 1919-1931: Part Two. *Science & Society*, *64*(2), 194–217.

Bhambra, G. K. (2014). Postcolonial and decolonial dialogues. *Postcolonial Studies*, *17*(2), 115–121. https://doi.org/10.1080/13688790.2014.966414

Bhuiyan, A. (2014). Intellectual Property Rights on the Internet: The Global South's Struggle for a Lenient Regime. In A. Bhuiyan (Ed.), *Internet Governance and the Global South:*

Demand for a New Framework (pp. 113–135). Palgrave Macmillan UK. https://doi.org/10.1057/9781137344342_7

Bijker, W. E., Hughes, T. P., & Pinch, T. (2012). *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology* (D. G. Douglas, Ed.; anniversary edition edition). The MIT Press.

Bijker, W. E., & Law, J. (Eds.). (1994). *Shaping Technology / Building Society: Studies in Sociotechnical Change* (Reissue edition). The MIT Press.

Bilic, P. (2016). Search algorithms, hidden labour and information control. *Big Data & Society*, *3*(1). https://doi.org/10.1177/2053951716652159

Bilić, P. (2018). A Critique of the Political Economy of Algorithms: A Brief History of Google's Technological Rationality. *TripleC*, *16*(1), 315–331. https://doi.org/10.31269/triplec.v16i1.914

Birch, K. (2013). The Political Economy of Technoscience: An Emerging Research Agenda. *Spontaneous Generations: A Journal for the History and Philosophy of Science*, *7*(1), 49–61. https://doi.org/10.4245/sponge.v7i1.19556

Birch, K. (2017). Rethinking Value in the Bio-economy: Finance, Assetization, and the Management of Value. *Science, Technology, & Human Values*, *42*(3), 460–490. https://doi.org/10.1177/0162243916661633

Birch, K. (2020). Technoscience Rent: Toward a Theory of Rentiership for Technoscientific Capitalism. *Science, Technology, & Human Values*, *45*(1), 3–33. https://doi.org/10.1177/0162243919829567

Birch, K., & Muniesa, F. (Eds.). (2020). *Assetization: Turning Things into Assets in Technoscientific Capitalism*. The MIT Press.

Birch, K., & Tyfield, D. (2013). Theorizing the Bioeconomy: Biovalue, Biocapital, Bioeconomics or What? *Science, Technology, & Human Values*, *38*(3), 299–327. https://doi.org/10.1177/0162243912442398

Birhane, A. (2020). Algorithmic Colonization of Africa. *SCRIPTed*, *17*(2), 389–409. https://doi.org/10.2966/scrip.170220.389

Bjola, C. (2021). AI for development: Implications for theory and practice. *Oxford Development Studies*, *0*(0), 1–13. https://doi.org/10.1080/13600818.2021.1960960

Black, S. (2021). Lifelong learning as cruel optimism: Considering the discourses of lifelong learning and techno-solutionism in South African education. *International Review of Education*. https://doi.org/10.1007/s11159-021-09924-8

Block, F. L., & Keller, M. R. (2015). *State of Innovation: The U.S. Government's Role in Technology Development*. Routledge. https://doi.org/10.4324/9781315631905

Boellstorff, T., Nardi, B., Pearce, C., Taylor, T. L., & Marcus, G. E. (2012). *Ethnography and Virtual Worlds: A Handbook of Method*. Princeton University Press.

Boisselle, L. N. (2016). Decolonizing Science and Science Education in a Postcolonial Space (Trinidad, a Developing Caribbean Nation, Illustrates). *SAGE Open*, *6*(1), 2158244016635257. https://doi.org/10.1177/2158244016635257

Bonefeld, W. (2011). Primitive Accumulation and Capitalist Accumulation: Notes on Social Constitution and Expropriation. *Science & Society*, *75*(3), 379–399.

Bonilla-Silva, E. (2009). *Racism without Racists: Color-Blind Racism and the Persistence of Racial Inequality in America* (3rd edition). Rowman & Littlefield Publishers.

Bonneuil, C. (2000). Development as Experiment: Science and State Building in Late Colonial and Postcolonial Africa, 1930-1970. *Osiris*, *15*, 258–281.

Boucher, V. D. (2016). A few things we learned about tech hubs in Africa and Asia. *Mobile for Development*. https://www.gsma.com/mobilefordevelopment/programme/ecosystem-accelerator/things-learned-tech-hubs-africa-asia

Bowen, G. (2009). Document Analysis as a Qualitative Research Method. *Qualitative Research Journal*, *9*, 27–40. https://doi.org/10.3316/QRJ0902027

Bowie, A. (2022). Visualising the Generic Techno-Imaginary: Exploring the Visual Rhetoric of the South African Fourth Industrial Revolution Agenda as Articulated through Commercial Stock Images. *De Arte*, *0*(0), 1–26. https://doi.org/10.1080/00043389.2022.2029017

Bowman, W. (2015). Imagining a Modern Rwanda: Sociotechnological Imaginaries, Information Technology, and the Postgenocide State. In *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*. University of Chicago Press. https://www.universitypressscholarship.com/view/10.7208/chicago/9780226276663.001.0001/upso-9780226276496-chapter-4

Boyd, Danah, Levy, K., & Marwick, A. (2014). *The Networked Nature of Algorithmic Discrimination*. Open Technology Institute. http://www.danah.org/papers/2014/DataDiscrimination.pdf

Brás, J. G. V. (2021). For an epistemic decolonisation of education from the ubuntu philosophy. *Pedagogy, Culture & Society*, *0*(0), 1–16. https://doi.org/10.1080/14681366.2021.2011386

Braun, L. (2014). *Breathing Race into the Machine: The Surprising Career of the Spirometer from Plantation to Genetics* (1 edition). University of Minnesota Press.

Braverman, I. (2014). Governing the wild: Databases, algorithms, and population models as biopolitics. *Surveillance & Society*, *12*(1), 15.

Browne, S. (2015). *Dark Matters: On the Surveillance of Blackness* (Illustrated edition). Duke University Press.

Bryce, J. (2019). African Futurism: Speculative Fictions and "Rewriting the Great Book." *Research in African Literatures*, *50*(1), 1–19.

Burns, S. (2015). *Mobile Money and Financial Development: The Case of M-PESA in Kenya* (SSRN Scholarly Paper No. 2688585). https://doi.org/10.2139/ssrn.2688585

Byskov, M. F. (2021). What Makes Epistemic Injustice an "Injustice"? *Journal of Social Philosophy*, *52*(1), 114–131. https://doi.org/10.1111/josp.12348

Callon, M. (1984). Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay. *The Sociological Review*, *32*(1_suppl), 196–233. https://doi.org/10.1111/j.1467-954X.1984.tb00113.x

Calzati, S. (2022). 'Data sovereignty' or 'Data colonialism'? Exploring the Chinese involvement in Africa's ICTs: a document review on Kenya. *Journal of Contemporary African Studies*, *40*(2), 270–285. https://doi.org/10.1080/02589001.2022.2027351

Carman, M., & Rosman, B. (2021). Applying a principle of explicability to AI research in Africa: Should we do it? *Ethics and Information Technology*, *23*(2), 107–117. https://doi.org/10.1007/s10676-020-09534-2

Carrillo, I. R. (2014). The New Developmentalism and the Challenges to Long-Term Stability in Brazil. *Latin American Perspectives*, *41*(5), 59–74.

Carter, B., Jain, S., Mueller, J., & Gifford, D. (2021, December 7). *Overinterpretation reveals image classification model pathologies*. 35th Conference on Neural Information Processing Systems (NeurIPS 2021). http://arxiv.org/abs/2003.08907

Chagnon, C. W., Durante, F., Gills, B. K., Hagolani-Albov, S. E., Hokkanen, S., Kangasluoma, S. M. J., Konttinen, H., Kröger, M., LaFleur, W., Ollinaho, O., & Vuola, M. P. S. (2022). From extractivism to global extractivism: The evolution of an organizing concept. *The Journal of Peasant Studies*, *49*(4), 760–792. https://doi.org/10.1080/03066150.2022.2069015

Chakrabarty, D. (2007). *Provincializing Europe: Postcolonial Thought and Historical Difference* (1st edition). Princeton University Press.

Chimhangwa, K. (2020, January 30). How Zimbabwe's biometric ID scheme (and China's AI aspirations) threw a wrench into the 2018 election. *Global Voices Advox*. https://advox.globalvoices.org/2020/01/30/how-zimbabwes-biometric-id-scheme-and-chinas-ai-aspirations-threw-a-wrench-into-the-2018-election/

Chun, W. H. K. (2009). Introduction: Race and/as Technology; or, How to Do Things to Race. *Camera Obscura: Feminism, Culture, and Media Studies*, *24*(1 (70)), 7–35. https://doi.org/10.1215/02705346-2008-013

Chutel, L. (2018, May 25). *China is exporting facial recognition software to Africa, expanding its vast database*. Quartz. https://qz.com/africa/1287675/china-is-exporting-facial-recognition-to-africa-ensuring-ai-dominance-through-diversity/

Chuwa, L. T. (2016). *African Indigenous Ethics in Global Bioethics: Interpreting Ubuntu* (Softcover reprint of the original 1st ed. 2014 edition). Springer.

Clarke, J. H. (1988). Pan-Africanism: A Brief History of An Idea In the African World. *Présence Africaine*, *145*, 26–56.

Coeckelbergh, M. (2022). The Ubuntu Robot: Towards a Relational Conceptual Framework for Intercultural Robotics. *Science and Engineering Ethics*, *28*(2), 16. https://doi.org/10.1007/s11948-022-00370-9

Coleman, B. (2009). Race as Technology. *Camera Obscura: Feminism, Culture, and Media Studies*, *24*(1 (70)), 177–207. https://doi.org/10.1215/02705346-2008-018

Coleman, D. (2019). Digital Colonialism: The 21st Century Scramble for Africa through the Extraction and Control of User Data and the Limitations of Data Protection Laws. *Michigan Journal of Race and Law*, *24*(2), 417–439.

Collins, H. M., & Evans, R. (2002). The Third Wave of Science Studies: Studies of Expertise and Experience. *Social Studies of Science*, *32*(2), 235–296. https://doi.org/10.1177/0306312702032002003

Collins, P. H. (2008). *Black Feminist Thought: Knowledge, Consciousness, and the Politics of Empowerment* (1 edition). Routledge.

Comaroff, J., & Comaroff, J. (Eds.). (2001). *Millennial Capitalism and the Culture of Neoliberalism*. Duke University Press.

Comaroff, J., & Comaroff, J. (2011). *Theory from the South: Or, How Euro-America is Evolving Toward Africa* (1st edition). Routledge.

Comaroff, J., & Comaroff, J. (2012). Theory from the South: Or, how Euro-America is Evolving Toward Africa. *Anthropological Forum*, *22*(2), 113–131. https://doi.org/10.1080/00664677.2012.694169

Connell, R. (2007). *Southern Theory: Social Science And The Global Dynamics Of Knowledge* (1st edition). Polity.

Cooper, B. (2016). Intersectionality. *The Oxford Handbook of Feminist Theory*. https://doi.org/10.1093/oxfordhb/9780199328581.013.20

Cooren, F. (2014). *Organizational Discourse: Communication and Constitution*. Polity Press. http://ebookcentral.proquest.com/lib/york/detail.action?docID=1913917

Corbett, S. (2011). Creative Commons Licences, the Copyright Regime and the Online Community: Is there a Fatal Disconnect? *The Modern Law Review*, *74*(4), 503–531.

Cornwall, A., & Eade, D. (Eds.). (2010). *Deconstructing Development Discourse: Buzzwords and Fuzzwords*. Practical Action Publishing.

Couldry, N., & Mejias, U. A. (2019a). Data Colonialism: Rethinking Big Data's Relation to the Contemporary Subject. *Television & New Media*, *20*(4), 336–349. https://doi.org/10.1177/1527476418796632

Couldry, N., & Mejias, U. A. (2019b). *The Costs of Connection: How Data Is Colonizing Human Life and Appropriating It for Capitalism* (1 edition). Stanford University Press.

Couture, S., & Toupin, S. (2019). What does the notion of "sovereignty" mean when referring to the digital? *New Media & Society*, *21*(10), 2305–2322. https://doi.org/10.1177/1461444819865984

Crawford, K. (2016). Opinion | Artificial Intelligence's White Guy Problem. *The New York Times*. https://www.nytimes.com/2016/06/26/opinion/sunday/artificial-intelligences-white-guy-problem.html

Crawford, K. (2021). *Atlas of AI: Power, Politics, and the Planetary Costs of Artificial Intelligence*. Yale University Press.

Crenshaw, K. (1989). Demarginalizing the Intersection of Race and Sex: A Black Feminist Critique of Antidiscrimination Doctrine, Feminist Theory and Antiracist Politics. *University of Chicago Legal Forum*, *1989*(6). https://chicagounbound.uchicago.edu/uclf/vol1989/iss1/8

Crenshaw, K. (1991). Mapping the Margins: Intersectionality, Identity Politics, and Violence against Women of Color. *STANFORD LAW REVIEW*, *43*(6), 1241–1299.

Cruikshank, J. (2006). *Do Glaciers Listen?: Local Knowledge, Colonial Encounters, and Social Imagination* (New edition edition). UBC Press.

Cruz, C. C. (2021). Decolonizing Philosophy of Technology: Learning from Bottom-Up and Top-Down Approaches to Decolonial Technical Design. *Philosophy & Technology*, *34*(4), 1847–1881. https://doi.org/10.1007/s13347-021-00489-w

Dahlin, J., & Fredriksson, M. (2017). Extracting the commons. *Cultural Studies*, *31*(2–3), 253–276. https://doi.org/10.1080/09502386.2017.1303428

Daigle, B. (2021). Data Protection Laws in Africa: A Pan-African Survey and Noted Trends. *Journal Of International Commerce And Economics*. https://www.usitc.gov/staff_publications/jice/data_protection_laws_africa_pan_african_survey_and

Daly, S. (2012). Philanthropy as an Essentially Contested Concept. *Voluntas: International Journal of Voluntary and Nonprofit Organizations*, *23*(3), 535–557.

Dauda, B. (2017). African Humanism and Ethics: The Cases of Ubuntu and Omolúwàbí. In A. Afolayan & T. Falola (Eds.), *The Palgrave Handbook of African Philosophy* (pp. 475–491). Palgrave Macmillan US. https://doi.org/10.1057/978-1-137-59291-0_31

de la Bellacasa, M. P. (2011). Matters of care in technoscience: Assembling neglected things. *Social Studies of Science*, *41*(1), 85–106. https://doi.org/10.1177/0306312710380301

Delgado, R., Stefancic, J., & Harris, A. (2017). *Critical Race Theory (Third Edition): An Introduction* (3rd edition). NYU Press.

Desai, J., Watson, D., Wang, V., Taddeo, M., & Floridi, L. (2022). The epistemological foundations of data science: A critical analysis. *SSRN*. https://doi.org/10.2139/ssrn.4008316

Deutsch, J.-G., Probst, P., & Schmidt, H. (2002). *African modernities: Entangled meanings in current debate*. Heinemann.

Dibua, J. I. (2017). *Modernization and the Crisis of Development in Africa: The Nigerian Experience*. Routledge. https://doi.org/10.4324/9781351152921

D'Ignazio, C., & Klein, L. F. (2020). *Data Feminism*. https://doi.org/10.7551/mitpress/11805.001.0001

Dijk, T. A. van (Ed.). (1997). *Discourse as Structure and Process*. Sage Publications.

DiPersio, D., & Cieri, C. (2019). *The Linguistic Data Consortium: Developing and Distributing Language Resources4All*. https://www.ldc.upenn.edu/sites/www.ldc.upenn.edu/files/lt4all-2019-ldc-language-resources-4all-slides.pdf

Djelassi, S., & Decoopman, I. (2016). Innovation through interactive crowdsourcing: The role of boundary objects. *Recherche et Applications En Marketing (English Edition)*, *31*(3), 131–152. https://doi.org/10.1177/2051570716650160

Donnor, J. K. (2005). Racialized Technology: Computers, Commodification, and "Cyber-race." *Counterpoints*, *131*, 91–102. JSTOR.

Dourish, P., & Mainwaring, S. D. (2012). Ubicomp's colonial impulse. *Proceedings of the 2012 ACM Conference on Ubiquitous Computing*, 133–142. https://doi.org/10.1145/2370216.2370238

Dredge, D. (2017). Policy and Regulatory Challenges in the Tourism Collaborative Economy. In D. Dredge & S. Gyimóthy (Eds.), *Collaborative Economy and Tourism: Perspectives, Politics, Policies and Prospects* (pp. 75–93). Springer International Publishing. https://doi.org/10.1007/978-3-319-51799-5_6

Du Bois, W. E. B. (1903). *The Souls of Black Folk* (Illustrated edition). Chump Change.

Duan, Y., Edwards, J. S., & Dwivedi, Y. K. (2019). Artificial intelligence for decision making in the era of Big Data—Evolution, challenges and research agenda. *International Journal of Information Management*, *48*, 63–71. https://doi.org/10.1016/j.ijinfomgt.2019.01.021

Edler, J., Blind, K., Kroll, H., & Schubert, T. (2021). *Technology Sovereignty as an Emerging Frame for Innovation Policy – Defining Rationales, Ends and Means* (p. 40). Fraunhofer Institute for Systems and Innovation Research ISI.

Eikenberry, A. M., & Mirabella, R. M. (2018). Extreme Philanthropy: Philanthrocapitalism, Effective Altruism, and the Discourse of Neoliberalism. *PS: Political Science & Politics*, *51*(1), 43–47. https://doi.org/10.1017/S1049096517001378

Eisenstadt, S. N. (2000). Multiple Modernities. *Daedalus*, *129*(1), 1–29.

Elliott, D., & Koech, D. K. (2018). *Reimagining Science and Statecraft in Postcolonial Kenya: Stories from an African Scientist*. Routledge. https://doi.org/10.4324/9781315163840

Elliott, S. W. (2018, October 5). Artificial Intelligence, Robots, and Work: Is This Time Different? *Issues in Science and Technology*. https://issues.org/artificial-intelligence-

robots-and-work-is-this-time-different/https://issues.org/artificial-intelligence-robots-and-work-is-this-time-different/

Elshakry, M. (2010). When Science Became Western: Historiographical Reflections. *Isis*, *101*(1), 98–109. https://doi.org/10.1086/652691

Elshakry, M. (2016). *Reading Darwin in Arabic, 1860-1950* (Reprint edition). University of Chicago Press.

Enwezor, O. (2010). Modernity and Postcolonial Ambivalence. *South Atlantic Quarterly*, *109*(3), 595–620. https://doi.org/10.1215/00382876-2010-008

Esedebe, P. O. (1970). Origins and Meaning of Pan-Africanism. *Présence Africaine*, *73*, 109–127.

Eze, M. O. (2013). Pan Africanism: A Brief Intellectual History. *History Compass*, *11*(9), 663–674. https://doi.org/10.1111/hic3.12074

Fanon, F. (2005). *The Wretched of the Earth* (J.-P. Sartre & H. K. Bhabha, Eds.; R. Philcox, Trans.). Grove Press.

Fanon, F. (2008). *Black Skin, White Masks* (R. Philcox, Trans.). Grove Press.

Felt, U. (2015a). Keeping Technologies Out: Sociotechnical Imaginaries and the Formation of Austria's Technopolitical Identity. In *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power* (pp. 103–125). University of Chicago Press.

Felt, U. (2015b). Sociotechnical imaginaries of "the Internet", digital health information and the making of citizen-patients. In S. Hilgartner, C. Miller, & R. Hagendijk (Eds.), *Science and Democracy: Making Knowledge and Making Power in the Biosciences and Beyond* (1 edition, pp. 176–197). Routledge.

Felt, U., & Öchsner, S. (2019). Reordering the "World of Things": The Sociotechnical Imaginary of RFID Tagging and New Geographies of Responsibility. *Science and Engineering Ethics*, *25*(5), 1425–1446. https://doi.org/10.1007/s11948-018-0071-z

Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating Rigor Using Thematic Analysis: A Hybrid Approach of Inductive and Deductive Coding and Theme Development. *International Journal of Qualitative Methods*, *5*(1), 80–92. https://doi.org/10.1177/160940690600500107

Fischer, F., & Forester, J. (Eds.). (1993). *The Argumentative Turn in Policy Analysis and Planning*. Duke University Press.

Forkuor, G., Hounkpatin, O. K. L., Welp, G., & Thiel, M. (2017). High Resolution Mapping of Soil Properties Using Remote Sensing Variables in South-Western Burkina Faso: A Comparison of Machine Learning and Multiple Linear Regression Models. *PLoS ONE*, *12*(1). https://doi.org/10.1371/journal.pone.0170478

Foster, L. A. (2017). *Reinventing Hoodia: Peoples, Plants, and Patents in South Africa*. University of Washington Press.

Foucault, M. (1994). *The Order of Things: An Archaeology of Human Sciences* (Illustrated edition). Vintage.

Fowler, A. (2022). Civil Society and the Pluralization of African Philanthropy: A Case of Back to the Future? *Nonprofit and Voluntary Sector Quarterly*, *51*(1), 103–124. https://doi.org/10.1177/08997640211020134

Fox, N. J. (2011). Boundary Objects, Social Meanings and the Success of New Technologies. *Sociology*, *45*(1), 70–85. https://doi.org/10.1177/0038038510387196

Frahm, N., Doezema, T., & Pfotenhauer, S. (2022). Fixing Technology with Society: The Coproduction of Democratic Deficits and Responsible Innovation at the OECD and the European Commission. *Science, Technology, & Human Values*, *47*(1), 174–216. https://doi.org/10.1177/0162243921999100

Fuchs, C. (2010). Labor in Informational Capitalism and on the Internet. *The Information Society*, *26*(3), 179–196. https://doi.org/10.1080/01972241003712215

Fuchs, C. (2014). *Digital Labour and Karl Marx* (1 edition). Routledge.

Fuchs, C. (2016, January). Digital Labor and Imperialism. *Monthly Review; New York*, *67*(8), 14–24. http://dx.doi.org.ezproxy.library.yorku.ca/10.14452/MR-067-08-2016-01_2

Fuller, S. (1999). *Governance of Science*. Open University Press.

Fusch, P., Fusch, G., & Ness, L. (2017). How to Conduct a Mini-Ethnographic Case Study: A Guide for Novice Researchers. *The Qualitative Report*, *22*(3), 923–941.

Gaffley, M., Adams, R., & Shyllon, O. (2022). Artificial Intelligence. African Insight. A Research Summary of the Ethical and Human Rights Implications of AI in Africa. *HSRC & Meta AI and Ethics Human Rights Research Project for Africa – Synthesis Report.*, 17.

Gallagher, R. (2019). Export laws: China is selling on surveillance technology to the rest of the world. *Index on Censorship*, *48*(3), 35–37. https://doi.org/10.1177/0306422019876445

Gallie, W. B. (1955). Essentially Contested Concepts. *Proceedings of the Aristotelian Society*, *56*, 167–198.

Gamatié, A. (2015). *Computing in research and development in Africa: Benefits, trends, challenges and solutions*. Springer. https://doi.org/10.1007/978-3-319-08239-4

Gieryn, T. F. (1983). Boundary-Work and the Demarcation of Science from Non-Science: Strains and Interests in Professional Ideologies of Scientists. *American Sociological Review*, *48*(6), 781–795. https://doi.org/10.2307/2095325

Gieryn, T. F. (1995). Boundaries of Science. In S. Jasanoff, G. Markle, J. Petersen, & T. Pinch (Eds.), *Handbook of Science and Technology Studies, Revised Edition* (pp. 393–443). SAGE Publications, Inc. https://doi.org/10.4135/9781412990127

Giuliani, D., & Ajadi, S. (2019, July 10). 618 active tech hubs: The backbone of Africa's tech ecosystem. *Mobile for Development*. https://www.gsma.com/mobilefordevelopment/blog/618-active-tech-hubs-the-backbone-of-africas-tech-ecosystem/

Godin, B. (2017). *Models of Innovation: The History of an Idea*. The MIT Press.

Godin, B., & Vinck, D. (2017). *Critical Studies of Innovation: Alternative Approaches to the Pro-innovation Bias*. Edward Elgar Pub.

Goldstone, B., & Obarrio, J. (Eds.). (2017). *African Futures: Essays on Crisis, Emergence, and Possibility* (1 edition). University of Chicago Press.

Goss, A. (Ed.). (2021). *The Routledge Handbook of Science and Empire*. Routledge. https://doi.org/10.4324/9780429273360

Graham, M. (Ed.). (2019). *Digital Economies at Global Margins*. The MIT Press.

Gray, K. L., & Sarkeesian, A. (2020). *Intersectional Tech: Black Users in Digital Gaming* (Illustrated edition). LSU Press.

Gray, M. L., & Suri, S. (2019). *Ghost Work: How to Stop Silicon Valley from Building a New Global Underclass*. Houghton Mifflin Harcourt.

Groos, J. (2020). Crypto Politics: Notes on Sociotechnical Imaginaries of Governance in Blockchain Based Technologies. In J. Golding, M. Paganelli, & M. Reinhart (Eds.), *Sometimes Hard, Usually Soft: The Future of Knowledge Systems* (pp. 148–170). De Gruyter. https://doi.org/10.1515/9783110697841

Grossberg, A. C. (2015). *CeSTII Seminar on: Science, Technology and Innovation (STI) Strategy for Africa (STISA-2024)*. https://doi.org/10/2139

Guay, R., & Birch, K. (2022). A comparative analysis of data governance: Socio-technical imaginaries of digital personal data in the USA and EU (2008–2016). *Big Data & Society*, *9*(2), 20539517221112924. https://doi.org/10.1177/20539517221112925

Gwagwa, A., Kazim, E., & Hilliard, A. (2022). The role of the African value of Ubuntu in global AI inclusion discourse: A normative ethics perspective. *Patterns*, *3*(4), 100462. https://doi.org/10.1016/j.patter.2022.100462

Gwagwa, A., Kazim, E., Kachidza, P., Hilliard, A., Siminyu, K., Smith, M., & Shawe-Taylor, J. (2021). Road map for research on responsible artificial intelligence for development (AI4D) in African countries: The case study of agriculture. *Patterns*, *2*(12), 100381. https://doi.org/10.1016/j.patter.2021.100381

Habiyaremye, A., Kruss, G., & Booyens, I. (2020). Innovation for inclusive rural transformation: The role of the state. *Innovation and Development*, *10*(2), 155–168. https://doi.org/10.1080/2157930X.2019.1596368

Hagedorn, G., Mietchen, D., Morris, R. A., Agosti, D., Penev, L., Berendsohn, W. G., & Hobern, D. (2011). Creative Commons licenses and the non-commercial condition: Implications for the re-use of biodiversity information. *ZooKeys*, *150*, 127–149. https://doi.org/10.3897/zookeys.150.2189

Hagerty, A., & Rubinov, I. (2019). Global AI Ethics: A Review of the Social Impacts and Ethical Implications of Artificial Intelligence. *ArXiv:1907.07892 [Cs.CY]*. https://doi.org/10.48550/arXiv.1907.07892

Hajer, M. A. (2006). Doing Discourse Analysis: Coalitions, Practices, Meaning. In van den Brink, M. & Metze, T. (Eds.), *Words matter in policy and Planning: Discourse Theory and Method in the Social Sciences* (pp. 65–74). Planning, Institutions and Transforming Spaces (AMIDST, FMG), Rethinking politics, transnational society, network interaction and democratic governance (ASSR, FMG). https://dare.uva.nl/personal/pure/en/publications/doing-discourse-analysis-coalitions-practices-meaning(e9a062b7-099f-4f6c-b4e2-a018a0170da5).html

Hajer, M. A. (2011). *Authoritative Governance: Policy Making in the Age of Mediatization*. Oxford University Press.

Hanchard, M. (1999). Afro-Modernity: Temporality, Politics, and the African Diaspora. *Public Culture*, *11*(1), 245–268. https://doi.org/10.1215/08992363-11-1-245

Hanemaayer, A. (Ed.). (2022). *Artificial Intelligence and Its Discontents: Critiques from the Social Sciences and Humanities*. Springer International Publishing. https://doi.org/10.1007/978-3-030-88615-8

Haraway, D. (1988). Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective. *Feminist Studies*, *14*(3), 575–599. https://doi.org/10.2307/3178066

Haraway, D. (1990). *Primate Visions: Gender, Race, and Nature in the World of Modern Science* (1 edition). Routledge.

Harding, S. (1991). *Whose Science? Whose Knowledge?: Thinking from Women's Lives* (1st edition). Cornell University Press.

Harding, S. (2008). *Sciences from Below: Feminisms, Postcolonialities, and Modernities*. Duke University Press; JSTOR. https://doi.org/10.2307/j.ctv11smmtn

Harding, S. (Ed.). (2011). *The Postcolonial Science and Technology Studies Reader*. Duke University Press Books.

Harper-Shipman, T. D. (2019). *Rethinking Ownership of Development in Africa* (1st edition). Routledge.

Hassan, S. M. (2010). African Modernism: Beyond Alternative Modernities Discourse. *South Atlantic Quarterly*, *109*(3), 451–473. https://doi.org/10.1215/00382876-2010-001

Hassan, S. M. (2018). "How to Liberate Marx from his Eurocentrism?": Marxist Praxis in African/Black Contexts. *Nka Journal of Contemporary African Art*, *2018*(42–43), 28–43. https://doi.org/10.1215/10757163-7185725

Hassan, Y. (2020). The politics of sharing: Sociotechnical imaginaries of digital platforms. *Information Polity*, *25*(2), 159–176. https://doi.org/10.3233/IP-190203

Hassan, Y. (2022). Governing algorithms from the South: A case study of AI development in Africa. *AI & SOCIETY*. https://doi.org/10.1007/s00146-022-01527-7

Haug, S., Braveboy-Wagner, J., & Maihold, G. (2021). The 'Global South' in the study of world politics: Examining a meta category. *Third World Quarterly*, *42*(9), 1923–1944. https://doi.org/10.1080/01436597.2021.1948831

Hernandez Fuentes, A. P. (2022). Digital Cooperation and Technological Sovereignty to Close the Digital Gap in the Fourth Industrial Revolution. *Oasis-Observatorio De Analisis De Los Sistemas Internacionales*, *36*, 77–94. https://doi.org/10.18601/16577558.n36.06

Hilbert, M. (2016). Big Data for Development: A Review of Promises and Challenges. *Development Policy Review*, *34*(1), 135–174. https://doi.org/10.1111/dpr.12142

Hine, C. (2000). *Virtual Ethnography*. SAGE Publications Ltd. https://doi.org/10.4135/9780857020277

Hine, C. (2007). Multi-sited Ethnography as a Middle Range Methodology for Contemporary STS. *Science, Technology, & Human Values*, *32*(6), 652–671. https://doi.org/10.1177/0162243907303598

Hiruy, K. (2014). Using Multi-Sited Ethnographic Case Studies and Auto-Ethnography to Explore Bottom-Up Community Empowerment among African Communities in Australia. In *SAGE Research Methods Cases*. SAGE Publications, Ltd. https://doi.org/10.4135/978144627305014537443

Hodge, J. M. (2011). Science and Empire: An Overview of the Historical Scholarship. In B. M. Bennett & J. M. Hodge (Eds.), *Science and Empire: Knowledge and Networks of Science across the British Empire, 1800–1970* (pp. 3–29). Palgrave Macmillan UK. https://doi.org/10.1057/9780230320826_1

Holmes, J. (2001). Sociolinguistics. In N. J. Smelser & P. B. Baltes (Eds.), *International Encyclopedia of the Social & Behavioral Sciences* (pp. 14562–14569). Pergamon. https://doi.org/10.1016/B0-08-043076-7/03027-8

Holzmeyer, C. (2021). Beyond 'AI for Social Good' (AI4SG): Social transformations—not tech-fixes—for health equity. *Interdisciplinary Science Reviews*, *46*(1–2), 94–125. https://doi.org/10.1080/03080188.2020.1840221

Howard, A., & Isbell, C. (2020). Diversity in AI: The Invisible Men and Women. *MIT Sloan Management Review*. https://sloanreview.mit.edu/article/diversity-in-ai-the-invisible-men-and-women/

Huang, P., & Westman, L. (2021). China's imaginary of ecological civilization: A resonance between the state-led discourse and sociocultural dynamics. *Energy Research & Social Science*, *81*, 102253. https://doi.org/10.1016/j.erss.2021.102253

Hughes, T. P. (1987). The Evolution of Large Technological Systems. In D. G. Douglas, W. E. Bijker, T. P. Hughes, & T. Pinch (Eds.), *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology* (anniversary edition edition, pp. 51–82). The MIT Press.

Introna, L., & Nissenbaum, H. (2010). *Facial Recognition Technology A Survey of Policy and Implementation Issues*. http://eprints.lancs.ac.uk/49012/

Irani, L., Vertesi, J., Dourish, P., Philip, K., & Grinter, R. E. (2010). Postcolonial computing: A lens on design and development. *Proceedings of the 28th International Conference on Human Factors in Computing Systems - CHI '10*, 1311. https://doi.org/10.1145/1753326.1753522

Irwin, R., & White, T. H. (2019). Decolonising Technological Futures: A dialogical tryptich between Te Haumoana White, Ruth Irwin, and Tegmark's Artificial Intelligence. *Futures*, *112*, 102431. https://doi.org/10.1016/j.futures.2019.06.003

James, J. (2010). New Technology in Developing Countries: A Critique of the One-Laptop-Per-Child Program. *Social Science Computer Review*, *28*(3), 381–390. https://doi.org/10.1177/0894439309346398

Jasanoff, S. (Ed.). (2004). *States of Knowledge: The Co-production of Science and the Social Order* (1 edition). Routledge.

Jasanoff, S. (2006). Biotechnology and Empire: The Global Power of Seeds and Science. *Osiris*, *21*(1), 273–292. https://doi.org/10.1086/507145

Jasanoff, S. (2007). *Designs on Nature: Science and Democracy in Europe and the United States* (Annotated edition). Princeton University Press.

Jasanoff, S. (Ed.). (2011). The Practices of Objectivity in Regulatory Science. In C. Camic, N. Gross, & M. Lamont, *Social Knowledge in the Making* (1 edition, pp. 307–337). University of Chicago Press.

Jasanoff, S. (2015). Future Imperfect: Science, Technology, and the Imaginations of Modernity. In *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power* (pp. 1–33). University of Chicago Press. https://doi.org/10.7208/chicago/9780226276663.001.0001

Jasanoff, S. (2016). *The Ethics of Invention: Technology and the Human Future*. W. W. Norton & Company.

Jasanoff, S., & Kim, S.-H. (2009). Containing the Atom: Sociotechnical Imaginaries and Nuclear Power in the United States and South Korea. *Minerva*, *47*(2), 119–146.

Jasanoff, S., & Kim, S.-H. (2013). Sociotechnical Imaginaries and National Energy Policies. *Science as Culture*, *22*(2), 189–196. https://doi.org/10.1080/09505431.2013.786990

Jasanoff, S., & Kim, S.-H. (Eds.). (2015). *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power* (1 edition). University of Chicago Press.

Jegede, O., & Ncube, C. (2021). Science, Technology, Innovation Management for Industrial Development in South Africa: Implications for The Fourth Industrial Revolution. *International Journal of Innovation*, *15*(9), 23.

Jensen, C. B., Ballestero, A., de la Cadena, M., Fisch, M., & Ishii, M. (2017). New ontologies? Reflections on some recent 'turns' in STS, anthropology and philosophy. *Social Anthropology*, *25*(4), 525–545. https://doi.org/10.1111/1469-8676.12449

Jobin, A., Ienca, M., & Vayena, E. (2019). The global landscape of AI ethics guidelines. *Nature Machine Intelligence*, *1*(9), Article 9. https://doi.org/10.1038/s42256-019-0088-2

Johnson, M. N. P., & McLean, E. (2020). Discourse Analysis. In A. Kobayashi (Ed.), *International Encyclopedia of Human Geography (Second Edition)* (pp. 377–383). Elsevier. https://doi.org/10.1016/B978-0-08-102295-5.10814-5

Jordanous, A. (2020). Intelligence without Representation: A Historical Perspective. *Systems*, *8*(3), Article 3. https://doi.org/10.3390/systems8030031

Just, N., & Latzer, M. (2016). Governance by algorithms: Reality construction by algorithmic selection on the Internet. *Media, Culture & Society*, 0163443716643157.

Kahil, A. (2013). Modernity and Modernization in North Africa and the Middle East. *Journal of Urban History*, *39*(6), 1163–1167. https://doi.org/10.1177/0096144213491693

Kaijser, A., & Kronsell, A. (2014). Climate change through the lens of intersectionality. *Environmental Politics*, *23*(3), 417–433. https://doi.org/10.1080/09644016.2013.835203

Kanehira, N., & Liu, W. (2018). *Science, Technology and Innovation for SDGs Roadmaps*. United Nations Interagency Task Team on Science, Technology and Innovation for the SDGs. https://sustainabledevelopment.un.org/content/documents/19009STI_Roadmap_Background_Paper_pre_STI_Forum_Final_Draft.pdf

Kankanhalli, A., Charalabidis, Y., & Mellouli, S. (2019). IoT and AI for Smart Government: A Research Agenda. *Government Information Quarterly*, *36*(2), 304–309. https://doi.org/10.1016/j.giq.2019.02.003

Karar, H. (2019). Algorithmic Capitalism and the Digital Divide in Sub-Saharan Africa. *Journal of Developing Societies*, *35*(4), 514–537. https://doi.org/10.1177/0169796X19890758

Kaur-Gill, S., & Dutta, M. J. (2017). Digital Ethnography. In *The International Encyclopedia of Communication Research Methods* (pp. 1–10). John Wiley & Sons, Ltd. https://doi.org/10.1002/9781118901731.iecrm0271

Kazansky, B., & Milan, S. (2021). "Bodies not templates": Contesting dominant algorithmic imaginaries. *New Media & Society*, *23*(2), 363–381. https://doi.org/10.1177/1461444820929316

Kazmi, H., Munne-Collado, I., Mehmood, F., Syed, T. A., & Driesen, J. (2021). Towards data-driven energy communities: A review of open-source data sets, models and tools. *Renewable & Sustainable Energy Reviews*, *148*, 111290. https://doi.org/10.1016/j.rser.2021.111290

Kellner, D. (2002). Theorizing Globalization. *Sociological Theory*, *20*(3), 285–305. https://doi.org/10.1111/0735-2751.00165

Kiemde, S. M. A., & Kora, A. D. (2020). The Challenges Facing the Development of AI in Africa. *2020 IEEE International Conference on Advent Trends in Multidisciplinary Research and Innovation (ICATMRI)*, 1–6. https://doi.org/10.1109/ICATMRI51801.2020.9398454

Kiemde, S. M. A., & Kora, A. D. (2021). Towards an ethics of AI in Africa: Rule of education. *AI and Ethics*. https://doi.org/10.1007/s43681-021-00106-8

Kiggins, R. (Ed.). (2017). *The Political Economy of Robots: Prospects for Prosperity and Peace in the Automated 21st Century* (1st edition). Palgrave Macmillan.

Kim, E.-S. (2017). Sociotechnical Imaginaries and the Globalization of Converging Technology Policy: Technological Developmentalism in South Korea. *Science as Culture*, 1–23. https://doi.org/10.1080/09505431.2017.1354844

Kingiri, A. N. (2022). Exploring innovation capabilities build up in the deployment of crop biotechnology innovation in Kenya. *Innovation and Development*, *12*(2), 305–324. https://doi.org/10.1080/2157930X.2021.1884934

Klepper, S. (2010). The origin and growth of industry clusters: The making of Silicon Valley and Detroit. *Journal of Urban Economics*, *67*(1), 15–32. https://doi.org/10.1016/j.jue.2009.09.004

Kostyak, L., Shaw, D. M., Elger, B., & Annaheim, B. (2017). A means of improving public health in low- and middle-income countries? Benefits and challenges of international public–private partnerships. *Public Health*, *149*, 120–129. https://doi.org/10.1016/j.puhe.2017.03.005

Kouletakis, J. (2022). Decolonising Copyright: Reconsidering Copyright Exclusivity and the Role of the Public Interest in International Intellectual Property Frameworks. *GRUR International*, *71*(1), 24–33. https://doi.org/10.1093/grurint/ikab099

Krige, J., & Wang, J. (2015). Nation, Knowledge, and Imagined Futures: Science, Technology, and Nation-Building, Post-1945. *History and Technology*, *31*(3), 171–179. https://doi.org/10.1080/07341512.2015.1126022

Krotz, E. (1997). Anthropologies of the South: Their rise, their silencing, their characteristics. Critique of Anthropology, 17(3), 237–251. https://doi.org/10.1177/0308275X9701700302

Kukutai, T., & Taylor, J. (2016). *Indigenous Data Sovereignty: Toward an agenda*. ANU Press.

Kumssa, A., & Jones, J. F. (2014). Post-independence African Policy: African Socialism and the Organization of African Unity. *Public Administration Research*, *4*(1), Article 1. https://doi.org/10.5539/par.v4n1p12

Kwet, M. (2018). *Digital Colonialism: US Empire and the New Imperialism in the Global South* (SSRN Scholarly Paper ID 3232297). Social Science Research Network. https://doi.org/10.2139/ssrn.3232297

Langley, P., & Leyshon, A. (2017). Platform capitalism: The intermediation and capitalisation of digital economic circulation. *Finance and Society.*, *3*, 11–31. https://doi.org/10.2218/finsoc.v3i1.1936

Latour, B. (1983). Give Me a Laboratory and I Will Raise the World. In K. Knorr-Cetina & M. Mulkay (Eds.), *Science Observed: Perspectives on the Social Study of Science* (pp. 141–170). Sage.

Latour, B. (1993). *We Have Never Been Modern* (C. Porter, Trans.). Harvard University Press.

Law, J. (2004). *After Method: Mess in Social Science Research* (1 edition). Routledge.

Lee, M. K., Kusbit, D., Metsky, E., & Dabbish, L. (2015). *Working with Machines: The Impact of Algorithmic and Data-Driven Management on Human Workers*. 1603–1612. https://doi.org/10.1145/2702123.2702548

Leonelli, S. (2016). *Data-Centric Biology: A Philosophical Study*. University of Chicago Press.

Leong, N. (2013). RACIAL CAPITALISM. *Harvard Law Review*, *126*(8), 2151–2226.

Leroy, J., & Jenkins, D. (Eds.). (2021). *Histories of Racial Capitalism*. Columbia University Press.

Levenda, A. M., Richter, J., Miller, T., & Fisher, E. (2019). Regional sociotechnical imaginaries and the governance of energy innovations. *Futures*, *109*, 181–191. https://doi.org/10.1016/j.futures.2018.03.001

Liboiron, M. (2021). *Pollution Is Colonialism*. Duke University Press.

Lin, Y.-T., Hung, T.-W., & Huang, L. T.-L. (2021). Engineering Equity: How AI Can Help Reduce the Harm of Implicit Bias. *Philosophy & Technology*, *34*(1), 65–90. https://doi.org/10.1007/s13347-020-00406-7

Lippit, V. D. (2005). Capitalism, globalization, and technological change. In *Capitalism*. Routledge.

Lo Iacono, V., Symonds, P., & Brown, D. H. K. (2016). Skype as a Tool for Qualitative Research Interviews. *Sociological Research Online*, *21*(2), 103–117. https://doi.org/10.5153/sro.3952

Lobe, B., Morgan, D., & Hoffman, K. A. (2020). Qualitative Data Collection in an Era of Social Distancing. *International Journal of Qualitative Methods*, *19*, 1609406920937875. https://doi.org/10.1177/1609406920937875

Luitse, D., & Denkena, W. (2021). The great Transformer: Examining the role of large language models in the political economy of AI. *Big Data & Society*, *8*(2), 20539517211047736. https://doi.org/10.1177/20539517211047734

Lynch, C. R. (2020). Contesting Digital Futures: Urban Politics, Alternative Economies, and the Movement for Technological Sovereignty in Barcelona. *Antipode*, *52*(3), 660–680. https://doi.org/10.1111/anti.12522

Lyon, D. (2007). *Surveillance Studies: An Overview* (1st edition). Polity.

Mabrouk, A. B. E., Hmida, M. B. H., Fourati, C., Haddad, H., & Messaoudi, A. (2021). A Multilingual African Embedding for FAQ Chatbots. *ArXiv:2103.09185 [Cs.CL]*. https://doi.org/10.48550/arXiv.2103.09185

MacKenzie, D. (2017). A material political economy: Automated Trading Desk and price prediction in high-frequency trading. *Social Studies of Science*, *47*(2), 172–194. https://doi.org/10.1177/0306312716676900

MacKenzie, D., & Wajcman, J. (1999). *The Social Shaping of Technology* (2 edition). Open University Press.

Madden, P. (2020). *Figures of the week: Africa's preparedness for the Fourth Industrial Revolution*. The Brookings Institution. https://www.brookings.edu/blog/africa-in-focus/2020/03/11/figures-of-the-week-africas-preparedness-for-the-fourth-industrial-revolution/

Madianou, M. (2019). Technocolonialism: Digital Innovation and Data Practices in the Humanitarian Response to Refugee Crises. *Social Media + Society*, *5*(3), 2056305119863146. https://doi.org/10.1177/2056305119863146

Mager, A., & Katzenbach, C. (2021). Future imaginaries in the making and governing of digital technology: Multiple, contested, commodified. *New Media & Society*, *23*(2), 223–236. https://doi.org/10.1177/1461444820929321

Mahmoud, Y. (2015). Modernization, Development Studies and Modernity in Current African Debates. In S. Ross & A. C. Lindgren (Eds.), *The Modernist World*. Routledge Handbooks Online. https://doi.org/10.4324/9781315778334.ch16

Makulilo, A. B. (2015). Myth and reality of harmonisation of data privacy policies in Africa. *Computer Law & Security Review*, *31*(1), 78–89. https://doi.org/10.1016/j.clsr.2014.11.005

Makulilo, A. B. (2016). The Context of Data Privacy in Africa. In A. B. Makulilo (Ed.), *African Data Privacy Laws* (pp. 3–23). Springer International Publishing. https://doi.org/10.1007/978-3-319-47317-8_1

Malodia, S., Gupta, S., & Jaiswal, A. K. (2020). Reverse innovation: A conceptual framework. *Journal of the Academy of Marketing Science*, *48*(5), 1009–1029. https://doi.org/10.1007/s11747-019-00703-4

Mann, S., & Hilbert, M. (2020). AI4D: Artificial Intelligence for Development. *International Journal of Communication*, *14*(0), Article 0.

Manzi, T. (2012). Discourse Analysis. In S. J. Smith (Ed.), *International Encyclopedia of Housing and Home* (pp. 354–358). Elsevier. https://doi.org/10.1016/B978-0-08-047163-1.00621-4

March, C., & Schieferdecker, I. (2021). Technological Sovereignty as Ability, Not Autarky. In *CESifo Working Paper Series* (No. 9139; CESifo Working Paper Series). CESifo. https://ideas.repec.org/p/ces/ceswps/_9139.html

Marcus, G. E. (1995). Ethnography in/of the World System: The Emergence of Multi-Sited Ethnography. *Annual Review of Anthropology*, *24*, 95–117. JSTOR.

Marcus, G. E. (1998). *Ethnography through Thick and Thin*. Princeton University Press.

Marcus, G. E., & Fischer, M. M. J. (1999). *Anthropology as Cultural Critique: An Experimental Moment in the Human Sciences*. University of Chicago Press.

Martin, A., Myers, N., & Viseu, A. (2015). The politics of care in technoscience. *Social Studies of Science*, *45*(5), 625–641.

Martinez-Martin, N., & Cho, M. K. (2022). Bridging the AI Chasm: Can EBM Address Representation and Fairness in Clinical Machine Learning? *American Journal of Bioethics*, *22*(5), 30–32. https://doi.org/10.1080/15265161.2022.2055212

Masters, L. (2021). Africa, the Fourth Industrial Revolution, and digital diplomacy: (Re)Negotiating the international knowledge structure. *South African Journal of International Affairs*, *28*(3), 361–377. https://doi.org/10.1080/10220461.2021.1961605

Maurer, T., Skierka, I., Morgus, R., & Hohmann, M. (2015). Technological sovereignty: Missing the point? *2015 7th International Conference on Cyber Conflict: Architectures in Cyberspace*, 53–68. https://doi.org/10.1109/CYCON.2015.7158468

Mavhunga, C. C. (Ed.). (2017). *What Do Science, Technology, and Innovation Mean from Africa?* MIT Press.

Mavhunga, C. C. (2018). Modelling an African Research University: Notes towards an Interdisciplinary, Cross-Cultural and Anticipative Curriculum. *Journal of Higher Education in Africa / Revue de l'enseignement Supérieur En Afrique*, *16*(1/2), 25–50.

Mazzucato, M. (2013). *The Entrepreneurial State: Debunking Public vs. Private Sector Myths* (1 edition). Anthem Press.

Mbembe, A. (2017a). Africa in Theory. In *African Futures: Essays on Crisis, Emergence, and Possibility* (1 edition, pp. 211–230). University of Chicago Press.

Mbembe, A. (2017b). *Critique of Black Reason* (L. DuBois, Trans.). Duke University Press.

Mbembe, A. (2019). *Necropolitics*. Duke University Press.

Mbembe, A. (2021). *Out of the Dark Night: Essays on Decolonization* (p. 280 Pages). Columbia University Press.

Mbiti, I., & Weil, D. N. (2015). Mobile Banking: The Impact of M-Pesa in Kenya. In *African Successes, Volume III: Modernization and Development* (pp. 247–293). University of Chicago Press. https://doi.org/10.7208/chicago/9780226315867.003.0007

Mboya, T. (1963). African Socialism. *Transition*, *8*, 17–19. https://doi.org/10.2307/2934729

McCarthy, L. D. (2015). Africa's Science and Technology Strategy in the Thought of Kwame Nkrumah. *SOCRATES: An International, Multi-Lingual, Multi-Disciplinary, Refereed (Peer-Reviewed), Indexed Scholarly Journal*, *3*(1), 113–134.

McMichael, P. (2016). *Development and Social Change: A Global Perspective* (6th edition). Sage Publications.

McMillan Cottom, T. (2020). Where Platform Capitalism and Racial Capitalism Meet: The Sociology of Race and Racism in the Digital Society. *Sociology of Race and Ethnicity*, *6*(4), 441–449. https://doi.org/10.1177/2332649220949473

McMurray, A. J., & de Waal, G. A. (Eds.). (2019). *Frugal Innovation: A Global Research Companion*. Routledge. https://doi.org/10.4324/9780429025679

McMurray, A. J., Weerakoon, C., & Etse, D. (2019). Exploring the dark side of frugal innovation. In A. J. McMurray & G. A. de Waal (Eds.), *Frugal Innovation*. Routledge.

METI. (2019). *G20 Ministerial Statement on Trade and Digital Economy*. Ministry of Economy, Trade and Industry - Japan. https://www.meti.go.jp/press/2019/06/20190610010/20190610010-1.pdf

Mhlambi, S. (2020). From Rationality to Relationality: Ubuntu as an Ethical and Human Rights Framework for Artificial Intelligence Governance. *Carr Center Discussion Paper Series*, *2020–009*.

Mignolo, W. D. (2011). THE GLOBAL SOUTH AND WORLD DIS/ORDER. *Journal of Anthropological Research*, *67*(2), 165–188.

Miller, T. R. (2020). Imaginaries of Sustainability: The Techno-Politics of Smart Cities. *Science as Culture*, *29*(3), 365–387. https://doi.org/10.1080/09505431.2019.1705273

Mirowski, P. (2011). *Science-Mart*. Harvard University Press.

Mitchell, J. C. (2009). Case and Situation Analysis. In R. Gomm, M. Hammersley, & P. Foster (Eds.), *Case Study Method* (pp. 165–186). SAGE Publications Ltd. https://doi.org/10.4135/9780857024367.d12

Mitra, A., & Watts, E. (2002). Theorizing Cyberspace: the Idea of Voice Applied to the Internet Discourse. *New Media & Society*, *4*(4), 479–498. https://doi.org/10.1177/146144402321466778

Mladenović, M. N., Stead, D., Milakis, D., Pangbourne, K., & Givoni, M. (2020). Chapter Ten - Governance cultures and sociotechnical imaginaries of self-driving vehicle technology: Comparative analysis of Finland, UK and Germany. In D. Milakis, N. Thomopoulos, & B. van Wee (Eds.), *Advances in Transport Policy and Planning* (Vol. 5, pp. 235–262). Academic Press. https://doi.org/10.1016/bs.atpp.2020.01.001

Mohamed, S., Png, M.-T., & Isaac, W. (2020). Decolonial AI: Decolonial Theory as Sociotechnical Foresight in Artificial Intelligence. *Philosophy & Technology*, *33*(4), 659–684. https://doi.org/10.1007/s13347-020-00405-8

Moosavi, L. (2020). The decolonial bandwagon and the dangers of intellectual decolonisation. *International Review of Sociology*, *30*(2), 332–354. https://doi.org/10.1080/03906701.2020.1776919

Morawczynski, O. (2009). Exploring the usage and impact of "transformational" mobile financial services: The case of M-PESA in Kenya. *Journal of Eastern African Studies*, *3*(3), 509–525. https://doi.org/10.1080/17531050903273768

Morelli, N., Mulder, I., Concilio, G., Pedersen, J. S., Jaskiewicz, T., de Gotzen, A., & Arguillar, M. (2017). Open Data as a New Commons. Empowering Citizens to Make Meaningful Use of a New Resource. In I. Kompatsiaris, J. Cave, A. Satsiou, G. Carle, A. Passani, E. Kontopoulos, S. Diplaris, & D. McMillan (Eds.), *Internet Science* (Vol. 10673, pp. 212–221). Springer International Publishing Ag. https://doi.org/10.1007/978-3-319-70284-1_17

Morozov, E., & Bria, F. (2018). *Rethinking the Smart City: Democratizing Urban Technology*. Rosa Luxemburg Stiftung. https://rosalux.nyc/rethinking-the-smart-city/

Morvaridi, B. (2012). Capitalist Philanthropy and Hegemonic Partnerships. *Third World Quarterly*, *33*(7), 1191–1210. https://doi.org/10.1080/01436597.2012.691827

Moyo, B., & Ramsamy, K. (2014). African philanthropy, pan-Africanism, and Africa's development. *Development in Practice*, *24*(5/6), 656–671.

Mueller, V. C. (2007). Is there a future for AI without representation? *Minds and Machines*, *17*(1), 101–115. https://doi.org/10.1007/s11023-007-9067-1

Mugumbate, J., & Nyanguru, A. (2013). Exploring African philosophy: The value of ubuntu in social work. *Faculty of Social Sciences - Papers (Archive)*, 82–100.

Mullet, D. R. (2018). A General Critical Discourse Analysis Framework for Educational Research. *Journal of Advanced Academics*, *29*(2), 116–142. https://doi.org/10.1177/1932202X18758260

Murray, W. E. (2018). *Aid, Ownership and Development: The Inverse Sovereignty Effect in the Pacific Islands* (1st edition.). Routledge, an imprint of Taylor and Francis.

Mytelka, L. K. (1989). The Unfulfilled Promise of African Industrialization. *African Studies Review*, *32*(3), 77–137. https://doi.org/10.2307/524549

Nakamura, L., & Chow-White, P. (Eds.). (2011). *Race After the Internet* (1st edition). Routledge.

Namara, M., Wilkinson, D., Lowens, B. M., Knijnenburg, B. P., Orji, R., & Sekou, R. L. (2018). Cross-cultural perspectives on eHealth privacy in Africa. *Proceedings of the Second African Conference for Human Computer Interaction: Thriving Communities*, 1–11. https://doi.org/10.1145/3283458.3283472

Nandutu, I., Atemkeng, M., & Okouma, P. (2021). Integrating AI ethics in wildlife conservation AI systems in South Africa: A review, challenges, and future research agenda. *AI & SOCIETY*. https://doi.org/10.1007/s00146-021-01285-y

Nanfuka, J. (2022, January 27). *Data Privacy Still A Neglected Digital Right in Africa*. https://cipesa.org/2022/01/data-privacy-still-a-neglected-digital-right-in-africa/

Naude, P. (2019). Decolonising Knowledge: Can Ubuntu Ethics Save Us from Coloniality? *Journal of Business Ethics*, *159*(1), 23–37. https://doi.org/10.1007/s10551-017-3763-4

Ndlovu, M., & Makoni, E. N. (2014). The globality of the local? A decolonial perspective on local economic development in South Africa. *Local Economy*, *29*(4–5), 503–518. https://doi.org/10.1177/0269094214537960

Ndlovu-Gatsheni, S. J. (2018). *Epistemic Freedom in Africa: Deprovincialization and Decolonization* (1st edition). Routledge.

Ndung'u, N., & Signé, L. (2020). *The Fourth Industrial Revolution and digitization will transform Africa into a global powerhouse* (Foresight Africa 2020). The Brookings

Institution. https://www.brookings.edu/research/the-fourth-industrial-revolution-and-digitization-will-transform-africa-into-a-global-powerhouse/

Ngugi, B., Pelowski, M., & Ogembo, J. G. (2010). M-pesa: A Case Study of the Critical Early Adopters' Role in the Rapid Adoption of Mobile Money Banking in Kenya. *The Electronic Journal of Information Systems In Developing Countries*, *43*(1), 1–16. https://doi.org/10.1002/j.1681-4835.2010.tb00307.x

Ngũgĩ wa Thiong'o. (1986). *Decolonising the Mind: The Politics of Language in African Literature*. James Currey.

Ngũgĩ wa Thiong'o. (1993). *Moving the Centre: The Struggle for Cultural Freedoms*. James Currey.

Ngũgĩ wa Thiong'o. (2009). *Something Torn and New: An African Renaissance*. Civitas Books.

Ngwena, C. (2018). *What is Africanness?: Contesting nativism in race, culture and sexualities*. I-Go-Books.

Nkrumah, K. (1961). *I Speak of Freedom; a Statement of African Ideology* (First Edition). Frederick A Praeger Inc.

Nkrumah, K. (1964). *Africa Must Unite*. Frederick A. Praeger.

Nkrumah, K. (1965). *Neo-Colonialism: The Last Stage of Imperialism*. Humanities Press Intl Inc.

Nkrumah, K. (1967). *African Socialism Revisited*. https://www.marxists.org/subject/africa/nkrumah/1967/african-socialism-revisited.htm

Noble, S. U. (2016). A Future for Intersectional Black Feminist Technology Studies. *S&F Online*, *14.1*(13.3). http://sfonline.barnard.edu/traversing-technologies/safiya-umoja-noble-a-future-for-intersectional-black-feminist-technology-studies/

Noble, S. U. (2018). *Algorithms of Oppression: How Search Engines Reinforce Racism*. NYU Press.

Nuttall, S., & Mbembe, A. (Eds.). (2008). *Johannesburg: The Elusive Metropolis* (Illustrated edition). Duke University Press.

Nyagadza, B., Pashapa, R., Chare, A., Mazuruse, G., & Hove, P. K. (2022). Digital technologies, Fourth Industrial Revolution (4IR) & Global Value Chains (GVCs) nexus with emerging economies' future industrial innovation dynamics. *Cogent Economics & Finance*, *10*(1), 2014654. https://doi.org/10.1080/23322039.2021.2014654

Ó Riain, S. (2009). Extending the ethnographic case study. In D. Byrne & C. Ragin (Eds.), *The SAGE Handbook of Case-Based Methods* (1st edition). Sage Publications.

Obadare, E., & Krawczyk, K. (2022). Civil Society and Philanthropy in Africa: Parallels, Paradoxes and Promise. *Nonprofit and Voluntary Sector Quarterly*, *51*(1), 76–102. https://doi.org/10.1177/08997640211057453

O'Boyle, N. M., Guha, R., Willighagen, E. L., Adams, S. E., Alvarsson, J., Bradley, J.-C., Filippov, I. V., Hanson, R. M., Hanwell, M. D., Hutchison, G. R., James, C. A., Jeliazkova, N., Lang, A. S. I. D., Langner, K. M., Lonie, D. C., Lowe, D. M., Pansanel, J., Pavlov, D., Spjuth, O., … Murray-Rust, P. (2011). Open Data, Open Source and Open Standards in chemistry: The Blue Obelisk five years on. *Journal of Cheminformatics*, *3*, 37. https://doi.org/10.1186/1758-2946-3-37

OECD. (2016). Better Policies for 2030 An OECD Action Plan on the Sustainable Development Goals. OECD. https://www.oecd.org/dac/Better%20Policies%20for%202030.pdf

Ogbonnaya-Ogburu, I. F., Smith, A. D. R., To, A., & Toyama, K. (2020). Critical Race Theory for HCI. *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*, 1–16. https://doi.org/10.1145/3313831.3376392

Ojo, O. O. (2021). The Emergence of Artificial Intelligence in Africa and its Impact on the Enjoyment of Human Rights. *African Journal of Legal Studies*, 1–25. https://doi.org/10.1163/17087384-bja10061

Ojo, T. (2018). Political Economy of ICT4D and Africa. In J. Servaes (Ed.), *Handbook of Communication for Development and Social Change* (pp. 1–14). Springer. https://doi.org/10.1007/978-981-10-7035-8_64-1

Ojo, T. A. (2022). Digital Financial Inclusion for Women in the Fourth Industrial Revolution A Key towards Achieving Sustainable Development Goal 5. *Africa Review*, *14*(1), 98–123. https://doi.org/10.1163/09744061-20220204

Oksanen, K., & Hautamäki, A. (2014). Transforming regions into innovation ecosystems: A model for renewing local industrial structures. *The Innovation Journal*, *19*(2), 16.

Omidyar Network. (2009, December 3). Omidyar Network Commits $1.4M to Ushahidi to Broaden Crowdsourcing Platform's Impact. *Omidyar Network*. https://omidyar.com/news/omidyar-network-commits-1-4m-to-ushahidi-to-broaden-crowdsourcing-platforms-impact/

O'Neil, C. (2017). *Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy* (Reprint edition). Broadway Books.

Onyango, G. (2022). *Routledge handbook of public policy in Africa*. Routledge.

Ortega, M. (2017). Decolonial Woes and Practices of Un-knowing. *The Journal of Speculative Philosophy*, *31*(3), 504–516.

Ortt, J. R., Putten, D. van, Kamp, L. M., & Poel, I. van de (Eds.). (2020). *Responsible Innovation in Large Technological Systems*. Routledge. https://doi.org/10.4324/9781003019930

Overton, J. (2019). *Aid, ownership and development: The inverse sovereignty effect in the Pacific Islands*. Routledge.

Owen, R., Bessant, J. R., & Heintz, M. (2013). *Responsible innovation: Managing the responsible emergence of science and innovation in society*. John Wiley & Sons Inc.

Oyedemi, T. D. (2019). Global Digital Capitalism: Mark Zuckerberg in Lagos and the Political Economy of Facebook in Africa. *International Journal of Communication*, *13*(0),.

Paalee, F. L. N. (2017). An Examination of The Political Philosophy of Leopold Sedar Senghor, An African Independence Leader. *International Journal of Social Science and Economic Research*, *2*(3). https://ijsser.org/more2017.php?id=167

Pälli, P., Vaara, E., & Sorsa, V. (2009). Strategy as text and discursive practice: A genre-based approach to strategizing in city administration. *Discourse & Communication*, *3*(3), 303–318. https://doi.org/10.1177/1750481309337206

Pandey, P. (2014). Sociotechnical Imaginaries and India's Crusade for Nanotechnology. In *Yearbook 2014 of the Institute for Advanced Studies on Science, Technology and Society* (Vol. 65). Profil: Munich and Vienna.

Parayil, G. (2005a). Introduction: Information Capitalism. In G. Parayil (Ed.), *Political Economy and Information Capitalism in India: Digital Divide, Development and Equity* (pp. 1–10). Palgrave Macmillan UK. https://doi.org/10.1057/9780230595613_1

Parayil, G. (2005b). *Political Economy and Information Capitalism in India: Digital Divide, Development and Equity* (G. Parayil, Ed.; 2005 edition). Palgrave Macmillan.

Péloquin, C. (2017). Postcolonial Technoscience and Development Aid Insights from the political economy of locust control expertise. In D. Tyfield, R. Lave, S. Randalls, & C. Thorpe (Eds.), *The Routledge Handbook of the Political Economy of Science* (1 edition, pp. 378–389). Routledge.

Peña1, P., & Varon, J. (2019). *Decolonising AI: A transfeminist approach to data and social justice*. Global Information Society Watch. https://giswatch.org/sites/default/files/gisw2019_web_th4.pdf

Peralta, A. F., Kertesz, J., & Iniguez, G. (2021). Opinion formation on social networks with algorithmic bias: Dynamics and bias imbalance. *Journal of Physics-Complexity*, *2*(4), 045009. https://doi.org/10.1088/2632-072X/ac340f

Peters, M. A. (2017). Technological unemployment: Educating for the fourth industrial revolution. *Educational Philosophy and Theory*, *49*(1), 1–6. https://doi.org/10.1080/00131857.2016.1177412

Petersen, I. (2016). Achieving Co-Operation in an Aid-Funded Development Network Organisation (DNO): Lessons for Development Practitioners. *The European Journal of Development Research*, *28*(5), 916–933. https://doi.org/10.1057/ejdr.2015.60

Pfotenhauer, S., & Jasanoff, S. (2017a). Traveling Imaginaries: The "practice turn" in innovation policy and the global circulation of innovation models. In *The Routledge Handbook of the Political Economy of Science* (pp. 416–428). Routledge.

Pfotenhauer, S., & Jasanoff, S. (2017b). Traveling Imaginaries: The "practice turn" in innovation policy and the global circulation of innovation models. In D. Tyfield, R. Lave, S. Randalls, & C. Thorpe (Eds.), *The Routledge Handbook of the Political Economy of Science* (1 edition, pp. 416–428). Routledge.

Phan, T., Goldenfein, J., Mann, M., & Kuch, D. (2021). Economies of Virtue: The Circulation of 'Ethics' in Big Tech. *Science as Culture*, *0*(0), 1–15. https://doi.org/10.1080/09505431.2021.1990875

Phan, T., & Wark, S. (2021). Racial formations as data formations. *Big Data & Society*, *8*(2), 20539517211046376. https://doi.org/10.1177/20539517211046377

Philip, K., Irani, L., & Dourish, P. (2012). Postcolonial Computing: A Tactical Survey. *Science, Technology, & Human Values*, *37*(1), 3–29. https://doi.org/10.1177/0162243910389594

Phillips, N., & Hardy, C. (2002). *Discourse Analysis*. SAGE Publications, Inc. https://doi.org/10.4135/9781412983921

Pinch, T. (2007). The Sociology of Science and Technology. In C. D. Bryant & D. L. Peck (Eds.), *21st Century Sociology* (Vol. 1–2, p. II-266-II–275). SAGE Publications, Inc. https://doi.org/10.4135/9781412939645

Pinch, T., & Bijker, W. (1984). The Social Construction of Facts and Artefacts: Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other. *Social Studies of Science*, *14*(3), 399–441. JSTOR.

Pinch, T., & Swedberg, R. (Eds.). (2008). *Living in a Material World: Economic Sociology Meets Science and Technology Studies*. The MIT Press.

Pollock, A., & Subramaniam, B. (2016). Resisting Power, Retooling Justice: Promises of Feminist Postcolonial Technosciences. *Science, Technology, & Human Values*, *41*(6), 951–966. https://doi.org/10.1177/0162243916657879

Poskett, J. (2021). Racial science. In *The Routledge Handbook of Science and Empire*. Routledge.

Poster, W. R. (2019). Racialized Surveillance in the Digital Service Economy. In R. Benjamin (Ed.), *Captivating Technology: Race, Carceral Technoscience, and Liberatory Imagination in Everyday Life* (pp. 133–169). Duke University Press.

Powell, M. (2001). Knowledge, Culture & the Internet in Africa: A Challenge for Political Economists. *Review of African Political Economy*, *28*(88), 241–260.

Prinsloo, P., & Kaliisa, R. (2022). Data privacy on the African continent: Opportunities, challenges and implications for learning analytics. *British Journal of Educational Technology*, *53*(4), 894–913. https://doi.org/10.1111/bjet.13226

Prior, L. F. (Ed.). (2008). Document Analysis. In L. Given, *The SAGE Encyclopedia of Qualitative Research Methods* (pp. 231–232). SAGE Publications, Inc. https://doi.org/10.4135/9781412963909.n120

Quijano, A. (2000). Coloniality of Power and Eurocentrism in Latin America—Aníbal Quijano, 2000. *International Sociology*. http://journals.sagepub.com/doi/10.1177/0268580900015002005

Quist-Adade, C., & Royal, W. (2016). *Re-Engaging the African Diasporas: Pan-Africanism in the Age of Globalization*. Cambridge Scholars Publishing.

Rapanyane, M. B., & Sethole, F. R. (2020). The rise of artificial intelligence and robots in the 4th Industrial Revolution: Implications for future South African job creation. *Contemporary Social Science*, *15*(4), 489–501. https://doi.org/10.1080/21582041.2020.1806346

Ratten, V. (2019). *Frugal Innovation*. Routledge. https://doi.org/10.4324/9780429455803

Reijers, W., & Coeckelbergh, M. (2016). The Blockchain as a Narrative Technology: Investigating the Social Ontology and Normative Configurations of Cryptocurrencies. *Philosophy & Technology*, *31*(1), 103–130. https://doi.org/10.1007/s13347-016-0239-x

Ribera-Fumaz, R. (2019). Moving from Smart Citizens to Technological Sovereignty? In P. Cardullo, C. DiFeliciantonio, & R. Kitchin (Eds.), *Right to the Smart City* (pp. 177–191). Emerald Group Publishing Ltd. https://doi.org/10.1108/978-1-78769-139-120191013

Ricaurte, P. (2022). Ethics for the majority world: AI and the question of violence at scale. *Media, Culture & Society*, *44*(4), 726–745. https://doi.org/10.1177/01634437221099612

Richter, J. A., Tidwell, A. S. D., Fisher, E., & Miller, T. R. (2017). STIRring the grid: Engaging energy systems design and planning in the context of urban sociotechnical imaginaries. *Innovation: The European Journal of Social Science Research*, *30*(3), 365–384. https://doi.org/10.1080/13511610.2016.1237281

Roberts, D. (2011). *Fatal Invention: How Science, Politics, and Big Business Re-create Race in the Twenty-First Century*. The New Press.

Roberts, D. (2013). Law, Race, and Biotechnology: Toward a Biopolitical and Transdisciplinary Paradigm. *Annual Review of Law and Social Science*, *9*(1), 149–166. https://doi.org/10.1146/annurev-lawsocsci-102612-134009

Robinson, C. J. (2000). *Black Marxism: The Making of the Black Radical Tradition* (2 edition). The University of North Carolina Press.

Rodriguez, J. P. (2011). *Slavery in the modern world: A history of political, social, and economic oppression*. ABC-CLIO.

Rosenthal, C. (2018). *Accounting for Slavery: Masters and Management*. Harvard University Press.

Roulston, K., & Choi, M. (2018). Qualitative Interviews. In U. Flick, *The SAGE Handbook of Qualitative Data Collection* (pp. 233–249). SAGE Publications Ltd. https://doi.org/10.4135/9781526416070.n15

Runeson, P., Olsson, T., & Linåker, J. (2021). Open Data Ecosystems—An empirical investigation into an emerging industry collaboration concept. *Journal of Systems and Software*, *182*, 111088. https://doi.org/10.1016/j.jss.2021.111088

Sadowski, J., & Bendor, R. (2019). Selling Smartness: Corporate Narratives and the Smart City as a Sociotechnical Imaginary. *Science, Technology, & Human Values*, *44*(3), 540–563. https://doi.org/10.1177/0162243918806061

Said, E. W. (1979). *Orientalism* (1 edition). Vintage Press.

Salmons, J. (2014). *Qualitative Online Interviews: Strategies, Design, and Skills*. Sage Publications.

Sampath, P. G. (2016). Sustainable Industrialization in Africa: Toward a New Development Agenda. In P. G. Sampath & B. Oyelaran-Oyeyinka (Eds.), *Sustainable Industrialization in Africa: Toward a New Development Agenda* (pp. 1–19). Palgrave Macmillan UK. https://doi.org/10.1007/978-1-137-56112-1_1

Santos, B. de S. (2014). *Epistemologies of the South: Justice Against Epistemicide* (1st edition). Paradigm Publishers.

Sarewitz, D., & Pielke, R. A. (2007). The neglected heart of science policy: Reconciling supply of and demand for science. *Environmental Science & Policy*, *10*(1), 5–16. https://doi.org/10.1016/j.envsci.2006.10.001

Saurwein, F., Just, N., & Latzer, M. (2015). Governance of algorithms: Options and limitations. *Info*, *17*(6), 35–49. https://doi.org/10.1108/info-05-2015-0025

Scerri, M., & Lastres, H. M. M. (Eds.). (2020). *The Role of the State: BRICS National Systems of Innovation*. Routledge India. https://doi.org/10.4324/9780367818524

Schensul, J. J., & LeCompte, M. D. (2012). *Essential Ethnographic Methods: A Mixed Methods Approach* (Second edition). AltaMira Press.

Schieferdecker, I., & March, C. (2020). Digital Innovations and Technological Sovereignty. *Wirtschaftsdienst*, *100*(1), 30–35. https://doi.org/10.1007/s10273-020-2612-8

Schiølin, K. (2020). Revolutionary dreams: Future essentialism and the sociotechnical imaginary of the fourth industrial revolution in Denmark. *Social Studies of Science*, *50*(4), 542–566. https://doi.org/10.1177/0306312719867768

Schwab, K. (2016, January 14). The Fourth Industrial Revolution: What it means and how to respond. *World Economic Forum*. https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/

Schwab, K. (2017). *The Fourth Industrial Revolution*. PENGUIN GROUP.

Schwandt, T. A., & Gates, E. F. (2018). Case Study Methodology. In N. Denzin & Y. Lincoln (Eds.), *The SAGE Handbook of Qualitative Research* (5th edition). Sage Publications.

Sevignani, S. (2017). Surveillance, Classification, and Social Inequality in Informational Capitalism: The Relevance of Exploitation in the Context of Markets in Information. *Historical Social Research / Historische Sozialforschung*, *42*(1 (159)), 77–102. JSTOR.

Shapshak, T. (2016). *Kenya's iHub Enters a New Chapter*. Forbes. https://www.forbes.com/sites/tobyshapshak/2016/03/11/kenyas-ihub-enters-a-new-chapter/

Shrestha, Y. R., & Yang, Y. (2019). Fairness in Algorithmic Decision-Making: Applications in Multi-Winner Voting, Machine Learning, and Recommender Systems. *Algorithms*, *12*(9), 199. https://doi.org/10.3390/a12090199

Siegel, S. (2018). Participant Observation. In B. B. Frey (Ed.), *The SAGE Encyclopedia of Educational Research, Measurement, and Evaluation*. SAGE Publications, Inc. https://doi.org/10.4135/9781506326139.n505

Siminyu, K., Freshia, S., Abbott, J., & Marivate, V. (2020). AI4D -- African Language Data set Challenge. *ArXiv:2007.11865 [Cs]*. http://arxiv.org/abs/2007.11865

Sismondo, S. (2007). Science and Technology Studies and an Engaged Program. In E. J. Hackett, O. Amsterdamska, M. Lynch, & J. Wajcman (Eds.), *The Handbook of Science and Technology Studies* (third edition edition, pp. 13–32). The MIT Press.

Sismondo, S. (2011). *An Introduction to Science and Technology Studies*. Wiley-Blackwell.

Sismondo, S. (2020). Sociotechnical imaginaries: An accidental themed issue. *Social Studies of Science*, *50*(4), 505–507. https://doi.org/10.1177/0306312720944753

Smallman, M. (2020). 'Nothing to do with the science': How an elite sociotechnical imaginary cements policy resistance to public perspectives on science and technology through the machinery of government. *Social Studies of Science*, *50*(4), 589–608. https://doi.org/10.1177/0306312719879768

Smit, B., & Onwuegbuzie, A. J. (2018). Observations in Qualitative Inquiry: When What You See Is Not What You See. *International Journal of Qualitative Methods*, *17*(1), 1609406918816766. https://doi.org/10.1177/1609406918816766

Smith, A. W. M., & Jeppesen, C. (Eds.). (2017). *Britain, France and the Decolonization of Africa: Future Imperfect?* (Illustrated edition). UCL Press.

Smith, D. E. (1993). *Texts, Facts and Femininity: Exploring the Relations of Ruling* (1st edition). Routledge.

Smith, L. T. (2012). *Decolonizing Methodologies: Research and Indigenous Peoples* (2 edition). Zed Books.

Sörum, N., & Fuentes, C. (2022). How sociotechnical imaginaries shape consumers' experiences of and responses to commercial data collection practices. *Consumption Markets & Culture*, *0*(0), 1–23. https://doi.org/10.1080/10253866.2022.2124977

Sovacool, B. K. (2019). *Visions of Energy Futures: Imagining and Innovating Low-Carbon Transitions*. Routledge. https://doi.org/10.4324/9780367135171

Sovacool, B. K., Bergman, N., Hopkins, D., Jenkins, K. E., Hielscher, S., Goldthau, A., & Brossmann, B. (2020). Imagining sustainable energy and mobility transitions: Valence, temporality, and radicalism in 38 visions of a low-carbon future. *Social Studies of Science*, *50*(4), 642–679. https://doi.org/10.1177/0306312720915283

Sovacool, B. K., & Hess, D. J. (2017). Ordering theories: Typologies and conceptual frameworks for sociotechnical change. *Social Studies of Science*, *47*(5), 703–750. https://doi.org/10.1177/0306312717709363

Spivak, G. (2010). "Can the Subaltern Speak?" revised edition, from the "History" chapter of Critique of Postcolonial Reason. In R. Morris (Ed.), *Can the Subaltern Speak?: Reflections on the History of an Idea* (pp. 21–78). Columbia University Press.

Srivastava, P., & Hopwood, N. (2009). A Practical Iterative Framework for Qualitative Data Analysis. *International Journal of Qualitative Methods*, *8*(1), 76–84. https://doi.org/10.1177/160940690900800107

Srnicek, N. (2016). *Platform Capitalism*. Polity Press.

Stake, R. E. (2009). The Case Study Method in Social Inquiry. In R. Gomm, M. Hammersley, & P. Foster (Eds.), *Case Study Method* (pp. 18–26). SAGE Publications Ltd. https://doi.org/10.4135/9780857024367.d5

Star, S. L. (2010). This is Not a Boundary Object: Reflections on the Origin of a Concept. *Science, Technology, & Human Values*, *35*(5), 601–617. https://doi.org/10.1177/0162243910377624

Star, S. L. (2016). The Ethnography of Infrastructure—SUSAN LEIGH STAR, 1999. *American Behavioral Scientist*. http://journals.sagepub.com/doi/10.1177/00027649921955326

Star, S. L., & Griesemer, J. R. (1989). Institutional Ecology, "Translations" and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39. *Social Studies of Science*, *19*(3), 387–420.

Statista. (2022, August 1). *Africa: Employment in industry sector 2010-2020*. Statista. https://www.statista.com/statistics/1230877/employment-in-the-industry-sector-as-share-of-total-in-africa/

Steger, M. (2013). *Globalization: A Very Short Introduction* (3rd edition). Oxford University Press.

Stiglitz, J. E. (2017). *Globalization and its Discontents*. WW Norton.

Stoler, A. L., McGranahan, C., & Perdue, P. C. (Eds.). (2007). *Imperial Formations*. School for Advanced Research Press.

Storey, W. K. (2015). Cecil Rhodes and the Making of a Sociotechnical Imaginary for South Africa. In *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*. University of Chicago Press.

https://www.universitypressscholarship.com/view/10.7208/chicago/9780226276663.001.0001/upso-9780226276496-chapter-2

Suarez, M. (2019). What can multi-sited and digital ethnography contribute to innovation studies in the global South? *African Journal of Science, Technology, Innovation and Development*, *11*(4), 495–503. https://doi.org/10.1080/20421338.2018.1528703

Suarez-Villa, L. (2012). *Globalization and Technocapitalism: The Political Economy of Corporate Power and Technological Domination*. Ashgate Publishing, Ltd.

Subramaniam, B., Foster, L., Harding, S., Roy, D., & TallBear, K. (2016). Feminism, Postcolonialism, and Technoscience. In U. Felt, R. Fouche, C. A. Miller, & L. Smith-Doerr (Eds.), *The Handbook of Science and Technology Studies, fourth edition* (pp. 407–433). MIT Press.

Suchman, L. (2006). *Human-Machine Reconfigurations: Plans and Situated Actions* (2 edition). Cambridge University Press.

Suldovsky, B. (2016). In science communication, why does the idea of the public deficit always return? Exploring key influences. *Public Understanding of Science*, *25*(4), 415–426. https://doi.org/10.1177/0963662516629750

Sullivan, J. (2013). Skype: An Appropriate Method of Data Collection for Qualitative Interviews? *The Hilltop Review*, *6*(1). https://scholarworks.wmich.edu/hilltopreview/vol6/iss1/10

Sundberg, M. (2007). Parameterizations as Boundary Objects on the Climate Arena. *Social Studies of Science*, *37*(3), 473–488. https://doi.org/10.1177/0306312706075330

Suri, T. (2021). Mobile Money. In P. Njoroge & V. Murinde (Eds.), *50 years of central banking in Kenya: Regional and global perspectives* (First edition.). Oxford University Press.

Sutherland, E. (2020). The Fourth Industrial Revolution – The Case of South Africa. *Politikon*, *47*(2), 233–252. https://doi.org/10.1080/02589346.2019.1696003

Talja, S. (1999). Analyzing Qualitative Interview Data: The Discourse Analytic Method. *Library & Information Science Research*, *21*(4), 459–477. https://doi.org/10.1016/S0740-8188(99)00024-9

TallBear, K. (2013). *Native American DNA: Tribal Belonging and the False Promise of Genetic Science* (1 edition). University Of Minnesota Press.

Tenzek, K. E. (2017). Field Notes. In M. Allen (Ed.), *The SAGE Encyclopedia of Communication Research Methods*. SAGE Publications, Inc. https://doi.org/10.4135/9781483381411.n201

Thatcher, J., O'Sullivan, D., & Mahmoudi, D. (2016). Data colonialism through accumulation by dispossession: New metaphors for daily data. *Environment and Planning D: Society and Space*, *34*(6), 990–1006. https://doi.org/10.1177/0263775816633195

The AI Media Group South Africa. (2022, July). *State of AI in Africa Report 2022*. Gumroad. https://aiafricareport.gumroad.com/l/State_of_AI_in_Africa_2022

The World Bank. (2021). *Rural population (% of total population) | Data*. The World Bank. https://data.worldbank.org/indicator/SP.RUR.TOTL.ZS

Thomas, D. R. (2006). A General Inductive Approach for Analyzing Qualitative Evaluation Data. *American Journal of Evaluation*, *27*(2), 237–246. https://doi.org/10.1177/1098214005283748

Tidwell, J. H., & Tidwell, A. S. D. (2018). Energy ideals, visions, narratives, and rhetoric: Examining sociotechnical imaginaries theory and methodology in energy research.

Energy Research & Social Science, *39*, 103–107. https://doi.org/10.1016/j.erss.2017.11.005

Tironi, M., & Albornoz, C. (2021). Chapter 11 - The circulation of the Smart City imaginary in the Chilean context: A case study of a collaborative platform for governing security. In H. M. Kim, S. Sabri, & A. Kent (Eds.), *Smart Cities for Technological and Social Innovation* (pp. 195–215). Academic Press. https://doi.org/10.1016/B978-0-12-818886-6.00011-3

Toews, J. E. (2015). Linguistic Turn and Discourse Analysis in History. In J. D. Wright (Ed.), *International Encyclopedia of the Social & Behavioral Sciences (Second Edition)* (pp. 202–207). Elsevier. https://doi.org/10.1016/B978-0-08-097086-8.62143-8

Toonders, J. (2014, July 23). Data Is the New Oil of the Digital Economy. *Wired*. https://www.wired.com/insights/2014/07/data-new-oil-digital-economy/

Truby, J. (2020). Governing Artificial Intelligence to benefit the UN Sustainable Development Goals. *Sustainable Development*, *28*(4), 946–959. https://doi.org/10.1002/sd.2048

Tuck, E., & Yang, K. W. (2012). Decolonization is not a metaphor. *Decolonization: Indigeneity, Education & Society*, *1*(1), 1--40.

Tyfield, D. (2012). A Cultural Political Economy of Research and Innovation in an Age of Crisis. *Minerva*, *50*(2), 149–167.

Tyfield, D., Lave, R., Randalls, S., & Thorpe, C. (Eds.). (2017). *The Routledge Handbook of the Political Economy of Science* (1 edition). Routledge.

Ujomudike, P. O. (2016). Ubuntu Ethics. In H. ten Have (Ed.), *Encyclopedia of Global Bioethics* (pp. 2869–2881). Springer International Publishing. https://doi.org/10.1007/978-3-319-09483-0_428

Uleanya, C. (2022). Scholarly discourse of the fourth industrial revolution (4IR) and education in Botswana: A scoping review. *Education and Information Technologies*. https://doi.org/10.1007/s10639-022-11298-9

Uleanya, C., & Ke, Y. (2019). Review of Preparedness of Rural African Communities Nexus Formal Education in the Fourth Industrial Revolution. *South African Review of Sociology*, *50*(3–4), 91–103. https://doi.org/10.1080/21528586.2019.1639074

United Nations. (1948). *Universal Declaration of Human Rights*. United Nations; United Nations. https://www.un.org/en/about-us/universal-declaration-of-human-rights

United Nations. (2022). *Economic Development in Africa Report 2022* (p. 192). United Nations. https://unctad.org/publication/economic-development-africa-report-2022

Unwin, P. T. H., & Unwin, T. (2009). *ICT4D: Information and Communication Technology for Development*. Cambridge University Press.

van Leeuwen, T. (2006). Critical Discourse Analysis. In K. Brown (Ed.), *Encyclopedia of Language & Linguistics (Second Edition)* (pp. 290–294). Elsevier. https://doi.org/10.1016/B0-08-044854-2/00501-0

Vicente, P. N., & Dias-Trindade, S. (2021). Reframing sociotechnical imaginaries: The case of the Fourth Industrial Revolution. *Public Understanding of Science*, *30*(6), 708–723. https://doi.org/10.1177/09636625211013513

Vinuesa, R., Azizpour, H., Leite, I., Balaam, M., Dignum, V., Domisch, S., Felländer, A., Langhans, S. D., Tegmark, M., & Fuso Nerini, F. (2020). The role of artificial intelligence in achieving the Sustainable Development Goals. *Nature Communications*, *11*(1), Article 1. https://doi.org/10.1038/s41467-019-14108-y

Vinuesa, R., Azizpour, H., Leite, I., Balaam, M., Dignum, V., Domisch, S., Felländer, A., Langhans, S., Tegmark, M., & Nerini, F. F. (2019). The role of artificial intelligence in achieving the Sustainable Development Goals. *ArXiv:1905.00501 [Cs]*. http://arxiv.org/abs/1905.00501

Wairegi, A., Omino, M., & Rutenberg, I. (2021). AI in Africa: Framing AI through an African Lens. *Communication, Technologies et Développement*, *10*, Article 10. https://doi.org/10.4000/ctd.4775

Wall, P. J., Saxena, D., & Brown, S. (2021). Artificial Intelligence in the Global South (AI4D): Potential and Risks. *ArXiv:2108.10093 [Cs]*. http://arxiv.org/abs/2108.10093

Walsh, O. (2022). 'The human ocean of the colored races': Interwar Black internationalism, Marxism, and permanent revolution. *Labor History*, *0*(0), 1–15. https://doi.org/10.1080/0023656X.2022.2070735

Warschauer, M., & Ames, M. (2010). Can One Laptop per Child Save the World's Poor. *Journal of International Affairs*, *64*(1), 33–51.

Weiss, H. (2013). *Framing a Radical African Atlantic: African American Agency, West African Intellectuals and the International Trade Union Committee of Negro Workers*. Brill. https://brill.com/view/title/23872

Weller, S. (2017). Using Internet video calls in qualitative (longitudinal) interviews: Some implications for rapport. *International Journal of Social Research Methodology*, *20*(6), 613–625. https://doi.org/10.1080/13645579.2016.1269505

Wessels, B., Finn, R. L., Wadhwa, K., Sveinsdottir, T., Bigagli, L., Nativi, S., & Noorman, M. (2017). *Open Data and the Knowledge Society*. Amsterdam University Press. http://www.jstor.org/stable/j.ctt1pk3jhq

Williams, L., Bunda, T., Claxton, N., & MacKinnon, I. (2018). A Global De-colonial Praxis of Sustainability—Undoing Epistemic Violences between Indigenous peoples and those no longer Indigenous to Place. *The Australian Journal of Indigenous Education*, *47*(1), 41–53. https://doi.org/10.1017/jie.2017.25

Winner, L. (1980). Do Artifacts Have Politics? *Daedalus*, *109*(1), 121–136.

Womack, Y. L. (2013). *Afrofuturism: The World of Black Sci-Fi and Fantasy Culture* (None ed. edition). Lawrence Hill Books.

Wood, D. A. (2020). *Epistemic Decolonization: A Critical Investigation into the Anticolonial Politics of Knowledge* (1st ed. 2020 edition). Palgrave Macmillan.

Woot, P. de. (2017). *Responsible Innovation*. Routledge. https://doi.org/10.4324/9781351283960

World Economic Forum. (2018). *Driving the Sustainability of Production Systems with Fourth Industrial Revolution Innovation* [White Paper]. https://www.weforum.org/whitepapers/driving-the-sustainability-of-production-systems-with-fourth-industrial-revolution-innovation/

World Economic Forum. (2020). *Unlocking Technology for the Global Goals* [White Paper]. https://www.weforum.org/reports/unlocking-technology-for-the-global-goals/

Wyatt, S. (2007). Technological Determinism Is Dead; Long Live Technological Determinism. In E. J. Hackett, O. Amsterdamska, M. E. Lynch, & J. Wajcman (Eds.), *The Handbook of Science and Technology Studies*. MIT Press. http://ebookcentral.proquest.com/lib/york/detail.action?docID=3338749

Yang, Y., Zhuang, Y., & Pan, Y. (2021). Multiple knowledge representation for big data artificial intelligence: Framework, applications, and case studies. *Frontiers of*

Information Technology & Electronic Engineering, *22*(12), 1551–1558. https://doi.org/10.1631/FITEE.2100463

Yingi, E., Hlungwani, P. M., & Nyagadza, B. (2022). The Fourth Industrial Revolution (4IR) in the Heart of the SDG Agenda: The Role of Education in Zimbabwe. *Africa Review*, *14*(2), 213–229. https://doi.org/10.1163/09744061-01402001

Zarsky, T. (2016). The Trouble with Algorithmic Decisions: An Analytic Road Map to Examine Efficiency and Fairness in Automated and Opaque Decision Making. *Science, Technology, & Human Values*, *41*(1), 118–132. https://doi.org/10.1177/0162243915605575

Zhuo, Z., Larbi, F. O., & Addo, E. O. (2021). Benefits and Risks of Introducing Artificial Intelligence in Commerce: The Case of Manufacturing Companies in West Africa. *Amfiteatru Economic*, *23*(56), 174–194. https://doi.org/10.24818/EA/2021/56/174

Ziewitz, M. (2016). Governing Algorithms: Myth, Mess, and Methods. *Science, Technology, & Human Values*, *41*(1), 3–16. https://doi.org/10.1177/0162243915608948

Zuboff, S. (2019). *The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power* (1 edition). PublicAffairs.

Zumoff, J. A. (2012). The American Communist Party and the "Negro Question" from the Founding of the Party to the Fourth Congress of the Communist International. *Journal for the Study of Radicalism*, *6*(2), 53–89. https://doi.org/10.1353/jsr.2012.0012

10. Appendices

10.1. Appendix A: Codebook

Parent Code	Child Codes
African Context in AI	African AI Innovation African Data set African Visions of AI AI Adoption Capacity Building Challenges in the African Context Developmentalism Discourse Exclusion and Marginalization Infrastructure Responsible AI
AI Governance	Data and Privacy Government Policy Normative Ideas of AI Governance Open Data

AI Innovation	AI Applications AI ecosystem AI Funding AI Strategy Visions-Ideas Economic Opportunities Fourth Industrial Revolution Government AI Strategy Government Support Imaginations of Innovation Industry Discourse Innovation as Development Market and the State Racial Subsidy Tech-hub Discourse
Decolonization	Counter Ideas-Visions of Decolonization Decolonization as Contextual AI Transformative Adaptation

Global - Canada AI	Development Ownership Global-Local Tensions Universal AI Ethics Responsible Innovation in AI Global Partnerships International Development International Relation
Pan-Africanism	African AI Strategy Challenges African AI Strategy Vision-Idea Alternative Vision of Pan-Africanism Globalization Ideas of Pan-Africanism Normative Idea of Pan-Africanism Pan-African STI Discourse
Social Implications	Normative AI Benefits Normative AI Risks