

Bachelor Thesis

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Transition towards Digital Modernity in the Global South

The Contribution of AI to Sustainable
Development in Sub-Saharan African
Countries

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Abstract

The aim of this study is to analyze the perceived contribution of Artificial Intelligence (AI) to the achievement of societal oriented Sustainable Development Goals (SDG's) in Sub-Saharan African countries in the context of postcolonial power-structures and a transformation towards digital modernity. To do so, I conducted a content analysis on AI-policy papers implemented by three carefully selected countries: Liberia, Mauritius and South Africa. Given the consequences of modern colonialism and postcolonial power-structures, these countries struggle with a high level of inequality, poverty and exploitation. However, today's world is undergoing a transition towards digital modernity that impacts individuals and states at local, national and international level. With the implementation of e-health, e-education, e-participation and e-learning strategies, and in accordance with an increased provision of digital services, rather low developed countries in Sub-Saharan Africa can accelerate the achievement of societal oriented SDG's and thereby contribute to overall sustainable development. Nonetheless, specific obstacles and challenges, such as automation risks, ethical constraints and gaps in transparency and safety need to be carefully considered to reduce disadvantages of AI for sustainable development.

Key words: Artificial intelligence, digital modernity, sustainability, Sub-Sahara Africa, SDG's, postcolonialism, development theories

List of Abbreviations

AEC	African Economic Community
AI	Artificial Intelligence
AU	African Union
EC	European Commission
ECLAC	Economic Commission for Latin America and the Caribbean
EU	European Union
COMEST	Commission on the Ethics of Scientific Knowledge and Technology
HDI	Human Development Index
HU	Hermeneutic Unit
ICT	Information and communication technology
IDRC	International Development and Research Centre
IoT	Internet of Things
LDC	Least developed country
MoE	Ministry of Education
NDP	National development plan
NGO	Non-governmental organization
OAU	Organization of African Units
SDG	Sustainable Development Goal
StatsSA	Statistics South Africa
SSA	Sub-Sahara Africa
UN	United Nations

List of Tables and Figures

Table 1: Data collection – AI-policies.....	p. 19
Table 2: Coding scheme.....	p. 20
Table 3: Level of achievement of the SDG’s – Current assessment.....	p. 21
Table 4: Quantitative analysis – Code frequency.....	p. 22
Figure 1: Sustainable Development Goals.....	p. 13

Table of Contents

- 1 Introduction 6
- 2 Theoretical framework 8
 - 2.1 Geographical context..... 9
 - 2.1.1 Colonialism and postcolonial power-structures 9
 - 2.1.2 Development theories..... 11
 - 2.2 Sustainable Development Goal’s 12
 - 2.3 AI as a manifestation of digital modernity in developing countries..... 14
 - 2.4 Expectations 16
- 3 Methodology 17
 - 3.1 Research design 17
 - 3.2 Case selection..... 18
 - 3.3 Data collection..... 19
 - 3.4 Operationalization and structure of analysis 19
- 4 Data analysis..... 20
 - 4.1 Level of sustainable development 21
 - 4.2 AI-Policy Frameworks 22
 - 4.2.1 General appliance – SDG and sustainable development goals..... 23
 - 4.2.2 SDG 1 – No poverty 24
 - 4.2.3 SDG 2 – Zero hunger 25
 - 4.2.4 SDG 3 – Good health and well-being..... 25
 - 4.2.5 SDG 4 – Quality Education..... 27
 - 4.2.6 SDG 5 – Gender equality 28
 - 4.3 Expectations 29
- 5 Conclusion..... 30
 - 5.1 Answer to the theoretical Sub-questions (1-3) 30
 - 5.2 Answer to the analytical Sub-questions (4-6)..... 31
 - 5.3 Answer to the overall research question..... 32
 - 5.4 Limitations and future research 33
- 6 References 35
- 7 Data Appendix..... 39

1 Introduction

“Digital transformation, development and productivity in developing countries: is artificial intelligence a curse or blessing?” (Aly, 2020, p. 1)

Based on this statement, the present bachelor thesis is dedicated to study the relation between AI as a manifestation of digital modernity on one side, and sustainable development and well-being as defined in the Sustainable Development Goals (SDG's) on the other side. Economic implications of AI for developing countries have already been discussed (Aly, 2020). However, this thesis takes place from a different angle by focusing on the contribution of AI to the achievement of specific SDG's in Sub-Saharan Africa (SSA).

With the rise of digital transformation, AI plays a significant role in today's world. Digital and technological innovations are not only used by individuals, but also important for politics, businesses and industries. Especially over the last years, the Internet of Things (IoT) and information and communication technologies (ICT) have enabled human beings to act in ways that connect each and everyone. Therefore, an important research tradition studies the “Transition Toward Digital Modernity” (Nagono, 2018, p. 4), which involves new approaches in order to examine chances and challenges that come with AI and machine learning. (Carrasco-Sáez et al., 2017; Danyel & Schuhmann, 2018; Hall & Jarvie, 1992; Malter & Rindfleisch, 2019; Nagono, 2018) Even scholars from the 20th-century looked into the development towards a “mechanical universe” (Mumford, 1934) and a “technological society” (Ellul, 1964), which urges the society to consider the advantages and disadvantages of the technical dimension for different contexts. It is argued that digital modernity has become “a decisive factor in the development of modern industrial societies” (Danyel & Schuhmann, 2018, p. 348), but “the extent and speed of the digital takeover was largely unanticipated” (Malter & Rindfleisch, 2019, p. 3).

AI as a manifestation of digital modernity can be studied from different dimensions, such as security, social welfare, peace-building, or sustainability. This thesis focuses on the latter, namely sustainability. With signing the UN 2030 Agenda for Sustainable Development, countries worldwide have agreed on achieving the SDG's before 2030. However, economic, political, social and environmental capacities extensively differ between countries. Whereas industrialized countries mostly have the capacities to implement rules and regulations in order to achieve the SDG's, the vast majority of less developed countries lack necessary resources

and administrative structures to do so. From a postcolonial perspective, especially SSA countries still struggles with instability and exploitation due to modern colonialism. International institutions are supporting these countries in their transition towards digital modernity to advance well-being. This support may help them, but could also reinforce dependencies. Thereby, the universal appliance of the SDG's to all signed countries makes it difficult for SSA countries to comply with all 17 goals before 2030. Given this dilemma, new technologies are sometimes put forward as a grand solution for the achievement of SDG's in SSA counties. Therefore, I want to address following research question in this thesis:

“To what extent and how is AI perceived to contribute to the achievement of societal oriented SDG's in Sub-Saharan African countries in the context of postcolonial power-structures and a transformation towards digital modernity?”

The overall aim of this study is to investigate whether AI as a manifestation of digital modernity can be considered as a blessing to enhance sustainable development in former colonies and less developed countries in Sub-Saharan Africa. This will be done via the application of a content analysis on AI-policies implemented by three decisive cases: Liberia, Mauritius and South Africa. Because of the implementation of the SDG's in 2015 and the rather new phenomenon of AI, the setting takes places in the most recent developments within the field under study. Furthermore, three theoretical sub-questions (1-3) and three analytical sub-questions (4-6) are formulated to specify the research question and structure the thesis:

SQ 1. What impact does modern colonialism and postcolonial power-structures have on the development of Sub-Saharan African countries regarding modernization and development theories?

SQ 2. How can the concept of SDG's be defined?

SQ 3. What is reported in the research literature about the transition towards digital modernity in the context of the SDG's, more specifically in the geographical context of Sub-Saharan African countries?

SQ 4. What is the current level of achievement of the societal oriented SDG's in Sub-Saharan African countries?

SQ 5. What is the current state of art in the implementation of AI-policies, as a manifestation of digital modernity, in Sub-Saharan African countries for the achievement of societal oriented SDG's?

SQ 6. What lessons can be drawn from those countries that have implemented AI-policies to promote the achievement of societal oriented SDG's for other Sub-Saharan African countries?

The scientific relevance builds on an extensive literature review in which I identified a research gap where the majority of the research about digital modernity that has been published so far has not yet been contextualized, although it is highly relevant for different regions in the world (space) and in different transitional trajectories in digital modernity (time). I only found little evidence about studies that combine sustainability, colonialism, postcolonial power-structures and AI. Hence, this thesis aims to add to existing literature by focusing on the relation between AI as a manifestation of digital modernity on one side, and sustainable development and well-being as defined in the SDG's on the other side. Thereby, the study has certain implications for scholars who are interested in digital modernity defined in its tradition and, more specifically, in the context of sustainability. On the basis of my results, scholars can conduct further studies on this specific topic to develop an even richer understanding of the transition towards digital modernity. At the same time, the study is societally relevant because the results allow government agencies, policy makers and stakeholders from SSA countries to discuss whether AI should be considered to accelerate the achievement of the SDG's. Especially where resources or administrative structures may be lacking, digital transformation in the manifestation of AI can enhance well-being and sustainable development.

2 Theoretical framework

I use a deductive approach in which I derive expectations from a specific theoretical background which are being tested with the application of relevant methods to verify or falsify the expectations (Hyde, 2000) Therefore, I start by analyzing the geographical context of SSA countries regarding its historical transformation during the European colonialization and decolonialization before investigating postcolonial power-structures nowadays. In addition, modernization and dependency theories are used to better understand the broader picture as to how countries can develop (Sub-question 1). Afterwards I discuss the concept of SDG's (Sub-question 2) and conceptualize AI as a manifestation of digital modernity in developing countries (Sub-question 3). Lastly, on the basis of the theoretical framework, I formulate specific expectations.

2.1 Geographical context

The investigation of the geographical context of SSA countries is reflected in sub-question 1 which addresses the impact of modern colonialism and postcolonial power-structures on the development of SSA countries regarding modernization and dependency theories. SSA is a large region, consisting of 49 officially recognized countries. Due to its rich history, culture and language, it is almost impossible to study all countries under the same scope. Nevertheless, despite its diversity, the countries have different dimensions in common, especially with regard to the overall low development. I pose the expectation that the main reason for the underdevelopment of SSA countries can be attributed to colonialism and postcolonial power-structures which ultimately resulted in internal political, economic and social instability over the last decades.

2.1.1 Colonialism and postcolonial power-structures

According to Daniel Butt (2013), colonialism has three distinctive characteristics, namely domination, cultural imposition, and exploitation, and is about the settlement of a population into a new territory. In contrast, imperialism focuses on the power-structures “in which a foreign government administers a territory without significant settlement”. (Kohn & Reddy, 2017) Although I could further investigate differences and similarities between these two terms, the particular etymology is not relevant for this study. Because the majority of literature I found uses colonialism in the context of SSA countries, I will also use it as broad concept in this study.

While parts of African countries have already been colonized in early historical periods by Greeks under Alexander the Great (Boardman, 1980), modern colonization of African countries can be dated back to the 19th and 20th century. At the Berlin Conference of 1884-1885, the European colonization was officially regulated and the General Act of the Berlin Conference was formalized. As a result, Belgium, Great Britain, France, Germany, Italy Portugal and Spain competed in the “Scramble for Africa” (Pakenham, 1991) for the colonization of African countries. Resistance from the African population against the European colonialism has often led to more suppression. (Olusoga, 2015) Following World War 1 and 2, most of the African countries decolonized and became independent states because European powers no longer had the resources and capacities to control their colonies. Despite the independence of African countries, the decolonization often led to internal and external conflicts due to the lack of administrative and political structures. With the implementation of the Abuja Treaty in May 1994, the African Economic Community (AEC) has been officially established with the

objective “to promote economic, social and cultural development and the integration of African economies in order to increase economic self-reliance and promote an endogenous and self-sustained development” (Abuja Treaty, 1991, p. 8) Furthermore, the African Union (AU) was established to “promote unity and solidarity of African states, to spur economic development, and to promote international cooperation.” (Pletcher, n.D.)

Nonetheless, postcolonial power-structures are still present in the majority of African countries. According to Rita Abrahamsen (2003), postcolonialism is not a classical theory but a concept that investigates problems and ideas in contemporary social and political science, particularly in the context of African countries. Notwithstanding its critiques by various scholars, the concept can be used to examine the consequences of colonialism and imperial dominance: “Broadly, postcolonialism analyzes the effects, and enduring legacies, of colonialism and disavows Eurocentric master-narratives.” (Ogunyankin, 2019) Even today, the vast majority of African countries are faced with instability caused by modern colonialism. According to the Human Development Index (HDI), most of the countries are characterized by a relatively low or moderate level of human development, which is due to multiple internal and external factors on regional, national and international level. “From the perspective of world-systems theory, the economic exploitation of the periphery does not necessarily require direct political or military domination” (Kohn & Reddy, 2017). Instead, the colonial practices from the European empire have caused unequal economic relations between SSA countries and the global market. The dependency between capitalist and peripheral countries only reinforces the exploitation and hence the inequality as such.

Given this background, I am able to verify the expectation I have posed in the beginning of this section: The under-development of African countries is indeed caused by the modern colonialism and the challenges the countries were faced with after the decolonialization. Even today, postcolonial power-structures are present in Africans countries. The presented dilemma of international exploitation and inequality can be studied from the perspective of International Relation’s Theories and Development Theories, depending on the scope of the study. Theories like Marxism and Liberalism play a significant role when investigating motivations behind global policy decisions from national and international actors. However, studying African countries not only in the context of a postcolonial society, but also regarding the transitions towards digital modernity, I use development theories to further explain how SSA countries may be able to achieve sustainable development.

2.1.2 Development theories

“The term development is understood as a social condition within a nation, in which the authentic needs of its population are satisfied by the rational and sustainable use of natural resources and systems.” (Reyes, 2001, p. 1) Development can be studied from two perspectives: modernization theory and dependency theory. Modernization theory emerged after the Second World War as reaction to the rise of the United States as a leading nation, the communist movement and the decolonization and disintegration of European empires around the world. It posits that Western countries can be seen as modern whereas less developed countries from the Global South, such as SSA countries, are considered as traditional. In order to sustain development, traditional countries have to follow a homogenous and irreversible so-called Europeanization or Americanization process. It involves systematic, transformative and imminent elements which ultimately result in a convergence among societies. (Reyes, 2001) Thereby, national political, administrative and economic structures in less developed countries need to adapt to international trajectories. According to Henry Bernstein, development from the modernist perspective is viewed as “social process associated with (or subsuming) economic development (...) that constitutes a ‘universal pattern’” (Bernstein, 1971). Furthermore, the American economist W. W. Rostow has introduced a five step model that is designated to generalize the transformation of a society towards economic growth. The stages are to be divided between (1) the traditional society, (2) preconditions for take-off, (3) the take-off, (4) the drive to maturity, and (5) high mass consumption. With each stage having its own characteristics, “these descriptive categories are rooted in certain dynamic propositions about supply, demand, and the pattern of productivity.” (Rostow, 1959, p. 1) Ultimately, according to Rostow, modern societies reach a level beyond high mass consumption in which new challenges occur that impose the need to develop new theoretical and analytical frameworks in order to be solved.

By contrast, dependency theory emerged in the 1950s in accordance with the Prebisch model and from the research of the Economic Commission for Latin America and the Caribbean (ECLAC) to understand the lack of development in Latin America. It primarily focuses on the national and regional level of less developed countries. (Reyes, 2001) According to Ozoigbo Ikechukwu, “for development to be real it must be indigenous, it must come from the people and be based on their environment.” (Ikechukwu, 2016, p. 17) The theory involves different principles that highlight the importance of national capacity building, fiscal policy, and capitals by establishing an effective and legitimate government. It combines both, neo-Marxist perspectives and Keynes’ economic theory, by arguing that the industrial sector needs to be

recognized in terms of domestic markets. (Reyes, 2001) This means that central to the dependency theory is the independent development of the nation-state without external influences. When studying dependency school, it is by no means state-bound: Instead, the structure of the international system is the “key variable to be studied in order to understand the form that development has taken in non-communist industrializing countries.” (Smith, 1979, p. 248) The theory implies that Western countries exploit less developed countries by the way these countries are integrated in the international system and market. “In contrast to the development of the core nations which is self-contained, the development of nations in the Third World necessitates subordination to the core.” (Reyes, 2001)

Both theories are criticized because of their focus on the nation-state from a Western perspective. Instead, it is argued that more attention should be brought to international relations and dependencies between countries. (Reyes, 2001) Nonetheless, the theories serve as important orientation for the investigation on how less developed countries can achieve sustainable development. Therefore, they are highly relevant in the context of my study due to the analysis of the contribution of AI to the achievement of the SDG’s. While countries have implemented national development strategies, international agreements are put forward to support the achievement of sustainable development. The Agenda 2030 and with it the SDG’s play a significant role in the development of a nation-state and will further be elaborate in the next section.

2.2 Sustainable Development Goal’s

In this section I discuss the concept of SDG’s to answer my second sub-question. The level of SDG-achievement is used as dependent variable and highly relevant in the context of this study. Understanding the concept of SDG’s therefore allows me to analyze its relation to AI as manifestation of digital modernity in the analytical part of the thesis.

The SDG’s are part of the UN 2030 Agenda for Sustainable Development, adopted by the United Nations Member States in 2015, aiming to ensure sustainable development with the central promise to “leave no one behind”. Including 17 universal goals and 169 targets, countries worldwide shall take actions in order to “achieve a better and more sustainable future for all by 2030.” (United Nations, n.D.) The specific goals can be reviewed in *Figure 1*. Critical public discussions about the inconsistency, measurability, and monitoring of the SDG’s can be found in the literature. (Swain, 2017) However, I take official decisions made by international organizations in the context of this study for granted.

Figure 1. Sustainable Development Goals



The adoption of the SDG's builds upon the cooperation of the UN, UN Department of Economic and Social Affairs, as well as its member states and other international organizations, such as the EU over the last decades. In June 1992, "a comprehensive plan of action to build a global partnership for sustainable development to improve human lives and protect the environment" (United Nations, n.D.) has been set up at the UN Conference on Environment and Development in Brazil. At its follow-up conference Rio+20 summit in 2012, the SDG's have been formulated to be integrated into the Millennium Development Goals (MDG's) after their expiration in 2015, creating a political framework on how to achieve sustainable development.

In the present study I primarily focus on the societal dimensions of the SDG's, which include, according to the UNSSC, SDG 1 to 5: (1) no poverty, (2) zero hunger, (3) good health and well-being, (4) quality education, and (5) gender equality. (SDG Services, n.D.) This does not imply that other dimensions of the SDG's are less important to study. However, according to Maslow's hierarchy of needs theory, basic physiological needs must be satisfied before other elements like love, esteem and self-actualization can be fulfilled. These basic needs strongly correlate to the societal oriented SDG's and include, for instance, food, water, health or shelter. (McLeod, 2018)

The SDG's are universal goals to be achieved by all countries, despite their political or administrative structures, and despite their level of sustainable development. While some countries have necessary capacities to do so, other countries may be lacking behind. As argued in the introduction, the effects of AI for sustainable development have by far not been analyzed

enough. Today's society undergoes a transition towards digital modernity which involves challenges, but more importantly, comes with many chances. AI plays a crucial role worldwide. Hence it is necessary to investigate the perceived contribution of AI on the achievement of the SDG's. To do so, the next section aims to study AI as a manifestation of digital modernity in developing countries.

2.3 AI as a manifestation of digital modernity in developing countries

After a brief discussion of the concept of SDG's as dependent variable, I now have a closer look at the context of the independent variable, namely the level of AI-contribution. Today's globalized world is characterized by a transition towards digital modernity in which AI can be seen as a manifestation of digital modernity. This transition needs further elaboration to better understand the phenomenon under study. Therefore, sub-question 3 was formulated to assess the research literature about the transition towards digital modernity in the context of the SDG's and SSA countries.

Defining the concept of AI is rather difficult because there is no universal definition of AI yet. According to the OECD, "an AI system is a machine-based system that can, for a given set of human-defined objectives, make predictions, recommendations, or decisions influencing real or virtual environments. AI systems are designed to operate with varying levels of autonomy." (OECD, 2019) The European Commission defines AI as a "collection of technologies that combine data, algorithms and computing power." (European Commission, 2020, p. 2) UNESCO's World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) defines AI as "machines capable of imitating certain functionalities of human intelligence, including such features as perception, learning, reasoning, problem solving, language interaction, and even producing creative work." (UNESCO, 2019, p. 25) What all of these definitions have in common is the general application of AI in all sorts of public and private areas. It connects human beings and "machine learning" (Jean et al., 2016, p. 790) in a way that highly effects today's society.

A wide discourse about the chances and challenges that come with the use of AI for national governments, international organization, companies, and citizens can be found in existing literature. (Aly, 2020; Nagano, 2018; Ellul, 1964; Goralski & Tan, 2019; Guo & Li, 2018) It is being argued that "digital transformation can ease matters for some, while making life harder for others." (Aly, 2020, p. 2) While AI clearly has a positive effect on economic development

and labor productivity in developing countries (Aly, 2020), “it can also pose risks to human rights, the environment and other important elements of responsible business conduct (...).” (OECD, 2019) In the recently launched AI Index Report 2021, the growing importance of AI in different public areas is being highlighted. AI journal publications grew by 34.5% from 2019 to 2020 and technical performances of AI, such as computer visions and natural language processing, have increased (Stanford University, 2021, p. 19). Furthermore, Oxford Insights and the International Development and Research Centre (IDRC) have investigated following question: “How ready is a given government to implement AI in the delivery of public services to their citizens?” (Shearer, Stirling & Pasquarelli, 2020, p. 4). According to this study, European countries, North America and Australia are well equipped for the involvement of AI into national policies. What is particularly striking are differences between the Global South and Global North in the context of digital transformations. Especially African countries seem to struggle with the implementation of AI strategies.

Nonetheless, different scholars argue for the emergence of AI for sustainability. Vinuesa et al. (2020) have investigated the effect of AI on the achievement of the SDG’s and concluded that AI can contribute to 79 % of the targets of the SDG’s and therefore enables sustainable development. Goralski and Tan (2019) as well as Truby (2020) further argue that AI can especially contribute to economic development whereas Jean et al. (2020) and Hofer et al. (2020) introduce mechanisms on how to predict poverty by using mechanical techniques in order to reduce poverty, as set as number one goal of the SDG’s. Causal inferences between AI and sustainability are without a doubt verifiable. However, although the studies highlight the advantages that come with the use of AI, they also call attention to possible risks and problems like “gaps in transparency, safety, and ethical standards” (Vinuesa et al., 2020, p. 1) and the possibility that “it’s life-affirming and sustainability-promoting applications may also be used for evil (...).” (Goralski & Tan, 2019, p. 7). Especially in least developed countries (LDC) is a high possibility of automation risks that prevent sustainability. (Nagano, 2018) According to Gwagwa et al. (2020), AI deployment in Africa comes with a high level of diversity, including different types of problems that are being addresses, financial inclusion, the implementation of AI and geographical locations. Overall, digital modernity is undergoing a process that has started with the fourth technical revolution. Despite the chances that come with AI for sustainability, risks and challenges need to be considered. While the implementation of AI may be difficult for some SSA countries, the continent is overall expected to benefit from this revolution, as long as the involvement and adoption of AI is conducted in careful manners.

2.4 Expectations

I can pose four specific expectations on the basis of the theoretical framework that will further be discussed in the light of this study. Expectation 1 and 2 are derived from the theoretical literature on colonialism, postcolonial power-structures and modernization theories in the geographical context of SSA countries:

- Expectation 1: From the modernist perspective, there are no significant differences between SSA countries in their national AI-policies for the contribution and implementation of AI to the achievement of the SDG's.
- Expectation 2: From the dependency perspective, SSA countries that gained their official colonial independence earlier than others have a higher level of AI contribution for the achievement of the SDG's implemented in their national policies.

Expectation 1 can be explained with the idea that postcolonial power-structures and elements are similar between those SSA countries that have been colonized in the past. The theoretical background has shown that most of the colonized countries lack stability in their administrative and political structures. Thus, from the modernist perspective, colonization and postcolonial power-structure lead to similar causal inferences between AI and SDG's. *Expectation 2* argues that differences between the connection of both variables are attributed to the fact that those SSA countries that gained their independence earlier than other countries had been given more time to establish administrative and political structures that contribute to sustainability.

Furthermore, two expectations are derived from the combination of the theoretical literature on AI as a manifestation of modernity and its contribution to well-being as captured by SDG's:

- Expectation 3: Countries with a higher level of implemented AI-strategies perform better in the achievement of the SDG's.
- Expectation 4: Countries with a lower level of implemented AI-strategies perform better in the achievement of the SDG's.

Although SSA countries struggle with the implementation of AI, there is no doubt that AI effects the level of achievement of the SDG's. However, open to discussion is yet its extent. Scholars have contrary opinions about the causal inferences between AI and sustainable development. While some clearly argue for the positive effects of AI, others draw attention to the risks and challenges. With regard to the social and scientific relevance and on the basis of the research question, the findings of this study thereby allow other researchers to get a better insight into this issue from the perspective of different SSA countries.

3 Methodology

In this section, I explain the research methodology that I use to investigate the overall performance of SSA countries on the achievement of the SDG's and to what extent and how AI is used to contribute to this achievement. Furthermore, this section allows readers to critically assess the reliability and validity of my measurements by presenting (1) my research design, (2) case selection, (3) data collection, and (4) operationalization and structure of analysis.

3.1 Research design

The research design was chosen according to my research question and the aim of my study. Hence, the central method I use is an interpretive approach that seeks to develop "interpretations of interpretations." (Bevir & Rhodes, 2005, p. 3) This means that I primarily focus on the meaning of written words in the documents under study. From a holistic standpoint, I seek to understand details by analyzing various actions, goals and intentions found in policy papers. In this context, the theoretical framework is used to gain in-depth understanding of the researched phenomenon while the expectations serve as orientation throughout the thesis in order to interpret my findings. (Bevir & Rhodes, 2005)

I apply a content analysis on the basis of an exploratory research design. "A content analysis is a research method that provides a systematic and objective means to make valid inferences from verbal, visual, or written data in order to describe and quantify specific phenomena." (Downe-Wambolt, 1992, p. 314) The method allows me to develop a more precise understanding and gain new insights about AI as a manifestation of digital modernity in the context of sustainability. When conducting this analysis, a certain degree of planning is necessary to validate results. Planning stages involve the consideration of the aim of the study, sample and unit of analysis, method of data collection, method of analysis and practical implications (Bengtsson, 2016, p. 9), which will be further discussed in the next sections.

Two potential threats to my research include the reliability and validity of my measurements.. From an epistemological account, I depart from the premise that there is not one single truth. However, agreements on theoretical assumptions and empirical interpretations can be made by conducting a systematic analysis. Therefore, the software program Atlas.ti is used to make sure that my study can be replicated. While this ensures reliability, content validity, criterion validity and construct validity are met by covering all possible aspects of the concepts and correctly

relating the concepts to their indicators and other theoretically related variables. Hence, random errors are minimized by conducting a systematic and careful study.

3.2 Case selection

While I study SSA countries in general, I had to select specific cases to draw significant results on the basis of the findings. Therefore, I employ a multiple-case, replication design on the methodological logic of Robert K. Yin (2018). According to him, a case study should be conducted “when (1) your main research questions are “how” or “why” questions, (2) you have little or no control over behavioral events, and (3) your focus of study is a contemporary (as opposed to entirely historical) phenomenon – a “case”.” (Yin, 2018, p. 32) Since these criteria are met, a multiple comparative case study allows me to detect differences and similarities between cases with regard to the causal inference of the dependent and independent variable at this moment in time. While generalizations for other SSA countries are difficult to make (Yin, 2018, p. 53), I can at least generalize theoretical propositions as to how AI may foster sustainable development in general which serves as orientation for national governments.

After an extensive study of available literature and documents, I derived interesting, different and extreme cases on the basis of certain criteria because they allow for contextualization of the study:

1. The available data had to be written in English language. Especially among countries in West Africa and Central Africa, data was often only available in French language.
2. The country had to be a former colony in the 19th and 20th century because this study takes place in the context of postcolonial power-structures.
3. Official AI-policies had to be implemented after the implementation of the 2030 Agenda so that there is a possibility of the SDG’s to be mentioned.
4. The countries had to differ in their geographical locations because the African continent is considerably large and therefore difficult to study under the same scope.

Out of 49 SSA countries, I detected three cases on the basis of the developed criteria and fundamental differences in the independent characteristics of the phenomenon under study. While Mauritius is considered as East African country and gained its official independence in 1968, South Africa is part of Southern Africa and gained independence in 1934. In contrast, Liberia is part of West Africa and gained its independence in 1847. North African countries are

not part of Sub-Saharan Africa and data for Central African countries was not available for the criteria I posed. In how far AI is perceived to contribute to the achievement of the SDG's will thereby be investigated in these three countries. Furthermore, the year of colonial independence is important for answering the earlier formulated expectation 1 and 2.

3.3 Data collection

Based on the characteristics of an interpretative approach (Bevir & Rhodes, 2005), I mainly study qualitative data. The literature for the theoretical framework was either found by searching in databases, such as Sage, Scopus or Web of Science, or in connection with each other as some documents provided references to other documents which were relevant for this thesis. However, in order to conduct the content analysis and find an answer for my research question, I study official policy papers implemented by national governments of the selected cases. After an extensive research, a table consisting of 3 documents has been created:

Table 1. Data collection – AI-policies

Case	Main policy document
Liberia	ICT Policy (2019-2024)
Mauritius	Digital Government Transformation Strategy (2018-2022)
South Africa	National Integrated ICT Policy. White Paper (2016)

Notes: Full references can be found in the Data Appendix.

When having a closer look at each document, it is noticeable that they are not solely AI-policies but focus on ICT and digital transformation. Nonetheless, as explained in the conceptualization of AI, these concepts are subsets of AI and will therefore be studied as part of AI without further discussion.

3.4 Operationalization and structure of analysis

To draw relevant conclusions, the main concept of sustainable development and its correlation with the level of AI implemented in SSA countries need to be measured. Therefore, I use the data from the Sustainable Development Report 2020 and focus on the overall performance of the countries under study as well as the societal oriented SDG's 1 to 5 by analyzing the current assessment of each goal. (Sachs et al., 2020)

Studying the level of AI implemented in SSA countries takes place from a different angle. As explained earlier, I employ a content analysis on multiple cases. By using ATLAS.ti, I could store data and create codes, code families and networks in order to construct a Hermeneutic

Unit (HU) with which I could analyze the data. (Friese, 2012) The codes are derived from the theoretical framework and used on each of the documents presented in *Table 1*. Due to the fact that I focus on societal oriented SDG's, I created code-groups on the basis of the general appliance of the SDG's as well as the specific SDG's. As illustrated in *Table 2.*, each SDG is attributed with a specific code word that will be analyzed in order to study the perceived contribution of AI to societal oriented SDG's in SSA countries. I had to limit the number of code words to not exceed the scope of this thesis. In addition, only one code word is used for each code-group, apart from the general appliance. This enables me to compare the quantitative code frequency and draw relevant conclusions. While the codes I use are rather broad, I expect to find different contextualization among the documents.

Table 2. Coding scheme

Code-group	Code words
General appliance	SDG, sustainable development goals
SDG 1	Poverty
SDG 2	Hunger
SDG 3	Health
SDG 4	Education
SDG 5	Gender

4 Data analysis

This section serves as main part of my study in which I analyze the data on the basis of my theoretical framework. Special focus is placed on the emergence of AI for sustainability in SSA countries with regard to sub-questions 4 and 5 and the formulated expectations. To do so, I first analyze the overall performance on the SDG's with special focus on SDG 1 to 5 (Sub-question 4). Secondly, I analyze the current state of the art in the implementation of AI as a manifestation of digital modernity by studying the implemented AI-policies presented in *Table 1*. This serves as main part of my analysis, in which I divide SDG 1 to 5 and analyze the documents on the basis of my coding scheme via the application of a qualitative and quantitative content analysis (Sub-question 5). Afterwards, I discuss the posed expectations to combine the theoretical framework with the data analysis. Sub-question 6 will be answered in the concluding section on the basis of the results on sub-question 1 to 5.

4.1 Level of sustainable development

Before discussing the expectations, it is important to provide an overview of the goal achievement by the SSA countries under study, as reflected in sub-question 4. Sustainable development can be analyzed from different perspectives. Given the fact that the level of achievement of the SDG's is used as dependent variable in this study, the most meaningful way to study sustainable development is by analyzing the SDG score and ranking. This is done via the analysis of the Sustainable Development Report 2020 (Sachs et al., 2020) with special emphasis on the societal oriented SDG's. The report itself gives a detailed description on how each goal is measured and which indicators are used. For the sake of simplicity, I do not elaborate the methodology behind the assessment of the SDG-performance but focus on the overall achievement of the SDG's in the countries under study. On the basis of the available data from the report, I created *Table 3*.

Table 3. Level of achievement of the SDG's – Current assessment

Country	Global Ranking	Goal 1	Goal 2	Goal 3	Goal 4	Goal 5
SSA	N.A.	4	4	4	4	4
Liberia	162	4	4	4	4	4
Mauritius	108	1	3	3	2	3
South Africa	110	4	4	4	3	2

Source: Sachs et al., 2020. *Note:* Goal achievement measured by (1) "SDG achieved" (2) "challenges remain" (3) "significant challenges" (4) "major challenges".

SSA as region was included in the analysis to get a better understanding of the overall level of achievement of the SDG's. As illustrated, SSA countries in general are struggling with the achievement of the SDG's and face major challenges in all five goals. This can also be observed when looking at the current assessment of each individual country. On the one hand, Mauritius and South Africa score the highest in the SDG-performance while Liberia ranks the lowest. On the other hand, the overall performance compared to countries worldwide is rather low, with all three countries ranking lower than 100. Only Mauritius has achieved SDG 1 but is still faced with challenges regarding the other goals. In sharp contrast, Liberia is facing major challenges in the achievement of all five SDG's and South Africa especially struggles with SDG's 1 to 3.

On the basis of these scores I can analyze the perceived contribution of AI to the achievement of the societal oriented SDG's. This enables me to generalize theoretical propositions as to how SSA countries can accelerate the achievement the SDG's via the application of AI.

4.2 AI-Policy Frameworks

In this section I analyze the current state of the art in the implementation of AI-policies as manifestation of digital modernity in the context of the SDG's in the countries under study, as reflected in sub-question 5. In addition, this section serves as main orientation for the assessment of the earlier formulated expectations. Therefore, I conduct a content analysis by using ATLAS.ti to systemically code the documents presented in *Table 1*. What all three documents have in common is their focus on strategies as to how include ICT and AI into national policies in the context of a transformation towards digital modernity. The policies are connected to national development plans and thereby aim to contribute to sustainable development. However, the extent and implementation as how to do so differ. Therefore, I analyze the documents with regard to the general appliance of the SDG's and the SDG's 1 to 5 on the basis of a qualitative and quantitative analysis. For the quantitative analysis, I created *Table 4*. which represents the frequency of the codes presented in *Table 2*. in the documents presented in *Table 1*. Because the policy papers have a very different number of pages, I divided the frequency of the code words with the number of pages of each policy paper. This number shows how often a code word is mentioned on one page. In this context, a high frequency of code words does not necessarily imply that the SDG is considered to be more important than an SDG with a low frequency of code words. Therefore, the qualitative analysis is used to analyze the strengths and weaknesses of the statements made in the policy papers.

Table 4. Quantitative analysis – Code frequency

Code group	Code words	Mauritius (104 pages)	Liberia (73 pages)	South Africa (173 pages)	Total score (350 pages)
General appliance	SDG, sustainable development goals	18 (0.173)	10 (0.137)	1 (0.006)	29 (0.083)
SDG 1	Poverty	2 (0.019)	0 (0.00)	10 (0.058)	12 (0.034)
SDG 2	Hunger	3 (0.029)	0 (0.00)	0 (0.00)	3 (0.009)
SDG 3	Health	18 (0.173)	49 (0.671)	21 (0.121)	88 (0.251)
SDG 4	Education	19 (0.183)	75 (1.027)	24 (0.139)	118 (0.337)
SDG 5	Gender	5 (0.048)	33 (0.452)	2 (0.012)	40 (0.114)
Total score		65 (0.625)	167 (2.288)	58 (0.335)	290 (0.829)

Note: The number in brackets signifies how often a code word is mentioned on one page (code frequency divided by page numbers).

After a preliminary quantitative analysis of the data presented in *Table 4.*, I can argue that SDG 3 and 4 are mentioned relatively often while SDG 2 is only mentioned by one case. In addition, especially Liberia has a high frequency of the words under study, with Mauritius ranking second and South Africa ranking third. Nonetheless, the general appliance of the SDG's as such is mentioned in all three documents. On the basis of a qualitative analysis, I can further detect differences and similarities in order to gain in-depth understanding of the phenomenon under study. To conduct the analysis, I separate the code groups and systematically analyze the documents with regard to the code words and its use in the context of sustainable development. While some code words are mentioned only a few times, other word frequencies are much higher. Therefore, I carefully selected those statements and phrases that are relevant in the context of this study only. The analysis was conducted several times to ensure content validity and avoid selection bias. For the sake of simplicity and because I only analyze three documents (see *Table 3.*), I only use the country's name and page number in the analysis as reference. The full reference can be found in the Appendix.

4.2.1 General appliance – SDG and sustainable development goals

This code group applies to the code words “SDG” as well as “sustainable development goals”. From a quantitative perspective, Mauritius mentions the words most often, with 0.173 words per page. Liberia ranks second (0.137) and South Africa ranks third (0.006). This shows that the SDG's as such play some role in the implementation of AI-policies in all three countries and is reflected in the attempt to enable AI for sustainable development. From a qualitative perspective, the implementation of AI for the achievement of the SDG's is connected to the achievement of national development strategies, such as the South African National Development Plan (NDP), the Public Sector Business Transformation Strategy (PSBTS) for achieving Government's Vision 2030 in Mauritius as well as the Structure, Empower and Transform Strategy (SET) and the National Development Plan (NDP) from Liberia. South Africa emphasizes the general access to communication services by the interconnection between supply and demand issues (i.e. infrastructure, resources, accessibility for everyone) to “ensure that ICTs 'accelerate human progress, bridge the digital divide and develop knowledge societies'” (p. 11). This, in return, aims to contribute to the achievement of the SDG's, according to the policy document. However, it is also stated that African countries in general have to undergo a “paradigm shift” (p. 11) to meet the objectives of the policy document and ensure sustainable development. Similar statements are made in Liberia's policy paper.

However, the country also recognizes certain challenges that need to be addressed before AI can contribute to the achievement of the SDG's. The challenges include the "transformation into a knowledge-based economy and inclusive information society" (p. 1). Special emphasis is placed on universal access to IoT and ICT which can serve as the "engine of development that is expected across all SDGs" (p. 11). Moreover, Liberia aims to become a "middle-income country by 2030" (p. 14) by using AI and ICT to achieve the SDG's. Mauritius states that AI and ICT are "powerful enabler in the implementation of the 17 SDGs" (p. 17) and therefore designed a comprehensive list of ICT applications and recommendations for the achievement of each SDG. It is stated that ICT can be at least used up to some extent to accelerate the achievement of the SDG's (p. 97). On one hand, all three countries recognize the importance of AI for the achievement of the SDG's. On the other hand, the means to do so differ. Therefore, this will be further investigated by analyzing the societally oriented SDG's separately.

4.2.2 SDG 1 – No poverty

In order to analyze SDG 1, the code word "poverty" will be used. Particularly noticeable is that Liberia has not used that word in its policy paper even once while Mauritius used it twice (0.019 times per page) and South Africa referred to it 10 times (0.058 words per page). Because of the absence of the code word in Liberia's policy paper, which implies that AI may not be considered to reduce poverty, I focus on Mauritius and South Africa for the qualitative analysis. In accordance with the South African NDP, "the main purpose of this White Paper is to unlock the potential of ICTs to eliminate poverty and reduce inequality in the country by 2030." (p. 11) In detail, this it to be achieved "by drawing on the energies of its people, growing an inclusive economy, building capabilities, enhancing the capacity of the state, and promoting leadership and partnership throughout the society." (p. 24) As investigated earlier, South Africa strongly focuses on the implementation of communication services (see section 4.2.1 *General appliance*). Therefore, it is argued that value chains of the ICT sectors (i.e. small businesses) need to be strengthened (p. 148) so that AI can reduce poverty by creating more jobs. Furthermore, focus is placed on the inclusion of multiple stakeholders to address problems the country is faced with (i.e. decrease access gaps to digital services). Ultimately, it is argued that the reduction of poverty can create equality throughout the society (p. 27). However, clear strategies as to how AI will be integrated in national policies to reduce poverty are not being addressed. Although the importance of poverty reduction is pointed out, it remains ambiguous as to how this will be achieved. While South Africa focuses on communication services in the

context of poverty reduction, Mauritius highlights the importance of data in general and for the detection of poverty in more detail (p. 45). Furthermore, the policy paper recommends certain applications as how to reduce poverty. These include digital-by-default services that can be defined as followed: “Provision of services via the digital channel by default while at the same time assist users with limited digital skills in using digital services via support desks.” (p. 3) This means that certain public and private services (i.e. social security, mobile banking, agriculture services etc.) are to be made available in online forms to provide access to everyone and thereby reduce poverty indirectly. Especially poor and marginalized populations as well as small businesses are central for the digital inclusiveness (p. 97).

4.2.3 SDG 2 – Zero hunger

SDG 2 will be analyzed with regard to code word “hunger”. It is mentioned the rarest among the code groups in the policy papers, with only Mauritius mentioning the word 3 times (0.029 times per page). Although hunger is a basic physiological need, as elaborated in the theoretical framework on the basis of Maslow’s hierarchy of needs theory, the SDG is strongly connected to other SDG’s, especially SDG 1. With aiming for the reduction of poverty, the level of hunger decreases among vulnerable and poor populations. Another reason for the low degree of code frequency may be the economic focus of the policy papers because I do not study SDG reports but AI-policies in general. Nonetheless, Mauritius presents certain applications and recommendations for the achievement of the SDG by the use of e-business strategies for agriculture and mobile-friendly services. Strong focus is placed on the agricultural level where productivity and effectiveness can be increased via IoT. Furthermore, Mauritius proposes the implementation of warning systems to detect natural disasters, food security problems and animal disease outbreaks (p. 97).

4.2.4 SDG 3 – Good health and well-being

SDG 3 focuses on the code word “health” which is mentioned the second most often after SDG 4 “education”. Among the countries under study, Liberia mentions the word 0.671 times per page, South Africa 0.121 times per page and Mauritius 0.173 times per page. All three policy papers introduce e-health strategies that contribute to the achievement of the SDG with the enhancement of digital government services across the health sector. Especially Liberia wants to improve the use of ICT for the health sector because it is lacking behind other West African

countries (p. 4). One target, amongst others, is the general internet access for all clinics and hospitals in the country (p. 9). This is to be achieved with the construction of a broadband infrastructure (p. 19). In more detail, the Liberian e-health strategy includes the adoption of a “comprehensive Health Information System to facilitate effective administration and clinical practices, using integrated ICT platforms.” (p. 35) This is justified with the spread of Ebola Virus Diseases where “traditional administration of health services has proven to be inefficient and less responsive to the needs of its diverse stakeholders.” (p. 35) Therefore, the policy paper recommends four strategies for the implementation of the Health Information System that include the investment in National Fiber Backbone, the expansion of ICT infrastructure, the design of a national e-Health strategy, and an increased cooperation between stakeholders and development partners. Furthermore, the Ministry of Health wants to guarantee access to health facilities for all people by using a standardized health information system via the application of an e-health strategy and implementation of a Health Information System (p. 36). Although, these targets are still in progress and shall be achieved by the end of 2024, AI and ICT are used to strengthen Liberia’s health sector and thereby contribute to the achievement of SDG 3. South Africa’s policy paper makes similar implications, stating that the traditional health system is faced with certain challenges that can be addressed with the use of ICT (p. 2). Therefore, e-health can “improve access to quality health care for all people across the country. ICTs can also assist in proactive monitoring of disease incidence and allow patients to report on healthcare.” (p. 9) Especially mobile services can be used to increase health awareness and thereby improve the well-being of people (p. 9). Furthermore, specific e-rate regulations offer discounts to public health establishments of at least 50% on internet services (p. 30) and funding systems aim to contribute to the extension of access to digital government services including e-health programs (p. 34). Lastly, Mauritius focuses on e-business strategies, digital-by-default services, open data access, data sharing services and mobile-friendly services to implement a comprehensive e-health strategy. Therefore, e-health information systems that contain important data about patients are to be implemented. Moreover, Mauritius’ policy paper addresses the implementation of emergency transport services, video and audio channels that connect patients and doctors, digital systems that manage health assets and facilities, mobile apps that provide health-relevant information (especially for pregnant women and new mothers), online databases of diseases, and training of doctors through online instructions (p. 97).

4.2.5 SDG 4 – Quality Education

SDG 4 will be analyzed on the basis of the code word “education” which has been used 118 times in total (0.337 times per page) and is mentioned the most in the policy papers among the analyzed code words. This shows that education plays a crucial role in the development of a country and the AI-policies. Mauritius uses the word 0.183 times per page, Liberia uses it 1.027 times per page and South Africa uses it 0.337 times per page. From a qualitative perspective, Mauritius proposes digital-by-default services, e-business strategies and data sharing to achieve quality education at national level. ICT applications therefore focus on the digital connectivity of educational institutions, the training of teachers and students in ICT, and digital access to relevant literature as well as learning facilities (p. 98). South Africa wants to address low quality of school education by the use of e-learning facilities and ICT in the educational sector (p. 8) in order to increase opportunities for children and the youth (p. 1). Overall, focus is placed on providing e-services for the educational sector to increase “services delivered via the Internet, and over mobile technology (m-services) and other ICT platforms.” (p. 171) Similar to SDG 3, education institutions can get a discount of at least 50 % on Internet services (p. 30) and access to communication services shall be made available for everyone regardless of the level of education (p. 32). Furthermore, specific e-education programs can benefit from governmental funding (p. 34) and broadband for educational institutions shall be extended (p. 35). On the basis of a digital society, more people shall get access to education (p. 114). The policy paper especially addresses the need to develop and increase ICT skills to improve quality education and prepare the youth for the digital society (p. 125f., 156). Liberia proposes the enhancement of government services across all sectors including e-education services by the increased use of ICT (p. 4). Therefore, a National Education and Research Network will be established to provide access to digital education services (p. 1) and access to broadband to educational and research institutions (p. 48). While education plays a crucial role in mainstreaming gender and women (p. 27) and youth (p. 28) in ICT, e-education shall also be used for human resource development to develop certain digital skills (p. 29f.). Unlike South Africa and Mauritius, Liberia has worked out a specific e-education policy that will be adopted by the Ministry of Education (MoE). The aim is to transform traditional education practices towards a stronger reliance on ICT platforms in order to enhance efficiency and expand educational opportunities for all students. Strategies for the implementation include, for instance, the development of an e-learning environment and new curriculums, increased investments in the e-education sector, and the establishment of an education ICT center (p. 36).

4.2.6 SDG 5 – Gender equality

To analyze SDG 5, the code word “gender” is used and implies the attempt to achieve gender equality. Given the quantitative analysis, “gender” has been used the third most common after “education” and “health”, with a total score of 0.114 times per pages. In comparison, Liberia uses the word 0.452 times per page, Mauritius uses it 0.048 times per page and South Africa uses it 0.012 times per page. After a careful analysis of the South African policy paper, I identified that the country does not much focuses on the attempt of gender equality with the use of AI or ICT. Instead, it only refers to SDG 5 two times, stating that first, measuring progress in the accessibility to communications networks and e-governmental services between gender and age is difficult because of not yet disaggregated data in ICT access. This shall be addressed by the government in cooperation with Statistics South Africa (StatsSA) (p. 14). Secondly, the universal service and access to communication services is based on several principles which include the “accessibility and the ability of all people to use and access services regardless of education, disability, age, gender etc.” (p. 32). In contrast, Mauritius presents a number of different ICT applications that can be used to accelerate the achievement of SDG 5. These are based on digital-by-default services, e-business strategies, mobile-friendly services, open data and e-participation. Recommendations for ICT applications include, for instance, online information, e-services, e-participation and e-learning for women and girls (p. 98). In addition, capacity building of mobile technologies to start online businesses and the education of basic coding skill for women and girls can “eventually solve talent gaps and gender inequality in tech companies” (p. 99). Liberia’s policy paper includes a thematic policy focus area about mainstreaming gender and women in ICT. It clearly states that gender equality, which is yet a key barrier in the country, has to be achieved for sustainable development (p. 5). Therefore, the country wants to increase research on the use of ICT for gender equality and implement a national strategy to improve gender equity (p. 16). Furthermore, according to the policy paper, a huge gender digital divide between men and women needs to be decreased by gender-responsive ICT policies. 8 specific policy objectives have been worked out in the policy paper to achieve gender equality and increase the involvement of women. These include, for instance, more research on gender equality, the involvement of gender advocates in policy planning processes, the support of women-centered activities, and the establishment of certain quotas to increase the involvement of women in public programs. The targets are to be achieved via the development and use of ICT (p. 27).

4.3 Expectations

On the basis of the results from the data analysis, I am able to discuss the expectations which is relevant to answer my sub-questions and research question. Regarding *expectation 1*, I could detect significant differences between the countries under study in the perceived contribution of AI to the achievement of the SDG's. Hence, the expectation is not met because SSA countries develop in different contexts and therefore achieve sustainable development in different ways.

Expectation 2 focused on the development of SSA countries from the dependency perspective in the context of colonialism and postcolonial power-structures. While Liberia gained its independence the earliest among the countries under study (1847), it also has the highest level of AI strategies formulated in its national policies. Mauritius and South Africa gained their independence in the middle of the 20th century (1968 and 1934) and have significant less AI strategies worked out in their policy papers. Therefore, this expectation is met: Countries that gained their independence earlier than others have been given more time to establish administrative and political structures. This means that they have also been given more time to formulate and implement specific AI-policies that can contribute to the achievement of the SDG's.

Expectation 3 and *expectation 4* are strongly connected and contradict each other: However, on the basis of the quantitative and qualitative content analysis, I can neither completely verify nor falsify them. Instead, the level of SDG performance does not significantly affect the level of implemented AI-policies. Liberia scores the lowest in the achievement of the SDG's but has the highest score in the code frequency of the code words and formulated specific strategies as to how the achievement of the SDG's can be accelerated with the use of AI and ICT. In contrast, Mauritius scores in the SDG ranking better than South Africa but has a higher level of formulated AI-strategies in its policy paper included. Nonetheless, still noticeable is the low level of SDG performance but high level of AI-strategies in Liberia. From a theoretical perspective, this means that less developed SSA countries can consider implementing AI-strategies to accelerate the achievement of the SDG's when other capacities to meet the universal goals may be lacking. Therefore, AI serves as a blessing for SSA countries. Developing this conclusion on the basis of the theoretical framework and the data analysis has been the aim of my study and meets its societal and scientific relevance. While AI may be still developing, it should be strongly considered as a blessing to enhance sustainable development in former colonies and less developed countries in Sub-Saharan Africa.

5 Conclusion

The present thesis studied the relation between AI as a manifestation of digital modernity on one side, and sustainable development and well-being as defined in the SDG's on the other side. This sections aims to first, conclude the theoretical and analytical key findings by answering the sub-questions. Secondly, I answer the overall research question and thirdly, I discuss certain limitations and implications for future research

5.1 Answer to the theoretical Sub-questions (1-3)

The results of the theoretical sub-questions are based on my findings on the theoretical framework. In sub-question 1, I asked following: *“What impact does modern colonialism and postcolonial power-structures have on the development of Sub-Saharan African countries regarding modernization and development theories?”* SSA countries are in general rather low developed, have a high level of inequality and poverty and are faced with economic, environmental, social and political challenges at local, regional and national level. Due to modern colonialism in the 19th and 20th century, SSA countries still struggle with the establishment of adequate administrative and political structures to deal with current and future challenges. Even today, dependencies between Western countries (capitalist countries) and SSA countries (peripheral countries) reinforce exploitation and increase inequality. As to how these countries can achieve sustainable development can theoretically explained with the dependency and modernization theory but is practically much more complex. While international agreements may support national governments, they can also reinforce dependencies and thereby prevent independence, equality and stability.

Sub-question 2 asked following: *“How can the concept of SDG's be defined?”* The SDG's have been formulated in the UN 2030 Agenda for Sustainable Development and were integrated into the MDG's after their expiration in 2015. Consisting of 17 economic, social and environmental goals, the aim is to ensure sustainable development worldwide. While they are a result of an international agreement between the UN and national governments, countries worldwide are urged to adopt and implement policies and regulations in order to achieve the specific goals before 2030.

AI as manifestation of digital modernity can serve as useful tool to foster sustainable development where other resources or administrative structures are lacking. To analyze this in more detail, I formulated sub-question 3: *“What is reported in the research literature about the transition towards digital modernity in the context of the SDG's, more specifically in the*

geographical context of Sub-Saharan African countries?” After a brief literature review on conducted studies so far, I observed that digital modernity impacts everyone’s life in many ways (i.e. mobile devices, online services etc.). While it comes with some legal challenges and obstacles in the implementation, SSA countries can benefit from this transition towards digital modernity, as long as stakeholders and the civil society are included in decision-making processes. Scholars argue for the emergence of AI and ICT for sustainable development and state that it can contribute to the achievement of (some) SDG’s. Nonetheless, automation risks, gaps in transparency and ethical standards need to be considered in order to ensure sustainability.

5.2 Answer to the analytical Sub-questions (4-6)

The analytical sub-questions can be answered on the basis of the conducted data analysis. First, I analyzed the level of sustainable development in SSA countries to answer sub-question 4: *“What is the current level of achievement of the societal oriented SDG’s in Sub-Saharan African countries?”* On the basis of *Table 3.*, it is noticeable that SSA countries in general face major challenges in the achievement of each goal. In addition, the selected countries score rather low with only Mauritius having reached SDG 1. The countries still face significant and major challenges in the current assessment on the level of the achievement of the SDG’s.

Sub-question 5 focuses on the main part of the analysis: *“What is the current state of art in the implementation of AI-policies in Sub-Saharan African countries for the achievement of societal oriented SDG’s?”* Separated by each SDG, I analyzed implemented AI-policies of Liberia, Mauritius and South Africa regarding the quantitative and qualitative usage of earlier formulated code words. In general, the SDG’s have been mentioned by all countries and therefore play a role in the national policies. While SDG 1 and SDG 2 are mentioned comparably less, strong focus is placed on SDG 3 and SDG 4 and some focus is placed on SDG 5. Furthermore, the level of the state of art in the implementation of AI-policies for the achievement of the societal oriented SDG’s differs. While Liberia mentions the code words 2.288 times per page, Mauritius mentions them only 0.625 times and South Africa only 0.335 times. In order to reduce poverty, the countries aim to strengthen the economic sector and establish digital-by-default services across the countries so that especially poor population can access digital services and improve digital skills. For the achievement of SDG 2, only Mauritius proposes the idea to establish e-businesses that can contribute to agriculture and farming and implement warning systems to detect natural disasters, food security problems and animal

disease outbreaks. To ensure good health and well-being (SDG 3), the countries focus on the implementation of e-health strategies and the expansion of mobile services. This allows nationwide access to the health sector and therefore contributes to the achievement of the SDG. Similar findings were made on the analysis of SDG 4. Because education plays an important role in the development of a nation state and its population, the countries propose the implementation of e-education strategies and the development of certain digital skills to prepare students for the digital revolution. The countries under study also highlight the importance of gender equality (SDG 5). This can be done by implementing gender-responsive ICT policies, increasing the research on gender gaps and increasing the involvement of girls and women in e-participation and e-learning.

Lastly, sub-question 6 can be answered through a careful analysis of the results of sub-question 1 to 5: *“What lessons can be drawn from those countries that have implemented AI-policies to promote the achievement of societal oriented SDG’s for other Sub-Saharan African countries?”* Given the fact that all three countries under study have implemented AI-policies that also focus on the SDG’s, I can generally conclude that AI is put forward to contribute to sustainable development. While the vast majority of SSA countries do have such policies, many of them were formulated before the implementation of the SDG’s and should therefore be revised, also with regard to the steady transformation towards digital modernity. With the beginning of the fourth industrialization, AI can be used to achieve the SDG’s where administrative and political means are lacking.

5.3 Answer to the overall research question

Given the discussion of the expectations and sub-questions, I can now answer the overall research question: *“To what extent and how is AI perceived to contribute to the achievement of societal oriented SDG’s in Sub-Saharan African countries in the context of postcolonial power-structures and a transformation towards digital modernity?”*

While SSA countries still struggle with a high level of inequality, poverty and exploitation due to modern colonialism and postcolonial power-structures, the modernization theory and dependency theory are concerned with the question as to how these countries can develop. Apart from national development strategies, the UN and its member states agreed upon 17 specific goals to achieve sustainable development. However, due to the lack of resources and administrative capacities, the universal achievement of the goals before 2030 is difficult. Therefore, AI as a manifestation of digital modernity in less developed countries can serve as a

blessing to accelerate the achievement of the societal oriented SDG's. The construction of a systematic research methodology allowed me to conduct a content analysis on the main AI-policy papers implemented by Liberia, Mauritius and South Africa. The analysis of the results regarding four specific expectations allowed me to combine theoretical propositions and analytical findings. While I analyzed each SDG separately, I concluded that AI is expected and perceived to accelerate the achievement of the societal oriented SDG's. Mainly through the implementation of e-strategies in terms of e-health, e-education, e-learning and e-participation, as well as the expansion of mobile services and digital-by-default services, the countries under study contribute to the achievement of the SDG's via the application of AI. Where administrative or political structures are lacking due to exploitation and inequality, which are resulting from colonialism and postcolonial power-structures, AI, ICT and IoT are useful tools to foster sustainable development. This is also reflected in the dependency theory and was investigated in expectation 2. Although the extent as to how AI is perceived to contribute to the specific SDG's differs, there is no doubt that the countries under study generally expect to benefit from the transformation towards digital modernity, as long as certain challenges are being considered.

This theoretical proposition can be generalized: AI can theoretically foster sustainable development in SSA countries where the population is faced with certain political, economic, social and environmental challenges. Due to different geographical contexts and varying colonial and postcolonial power-structures, I conclude that AI serves as blessing for countries that struggle with achieving the universal SDG's before 2030. Although different scholars have come to similar conclusions (Aly, 2020; Goralski & Tan, 2019; Vinuesa et al., 2020), the context of my study differed due to its strong focus on AI and SDG's in SSA in the context of postcolonial power-structures and a transformation towards digital modernity. Hence, this study meets its scientific and societal relevance by making clear implications for other scholars as well as serving as guiding light for national governments on how to involve AI in national policies to ensure sustainability.

5.4 Limitations and future research

My thesis has certain limitations and specific recommendations for future research that need to be discussed. As I only analyzed three countries regarding their perceived contribution of AI to the achievement of the SDG's, the findings are only theoretically but not practically generalizable for other SSA countries. Therefore, conducting the analysis with similar

operationalization but different cases can increase the possible level of generalization for other SSA countries. Secondly, I only focused on the societal oriented SDG's but left out environmental and economic oriented goals. While it allowed me to gain more in-depth understanding of the phenomena, future studies could also analyze the contribution of AI to the achievement of other SDG's in order to get a better understanding of the overall state of the art of AI for sustainability. Thirdly, it can be analyzed in how far the formulated strategies have been adopted yet and how effective they actually are. Lastly, I excluded AI-relevant projects implemented by NGO's that contribute to the achievement of the SDG's. However, this can serve as another approach from a different angle to study the overall phenomena of AI as a manifestation of digital modernity in SSA countries.

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7 Data Appendix

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