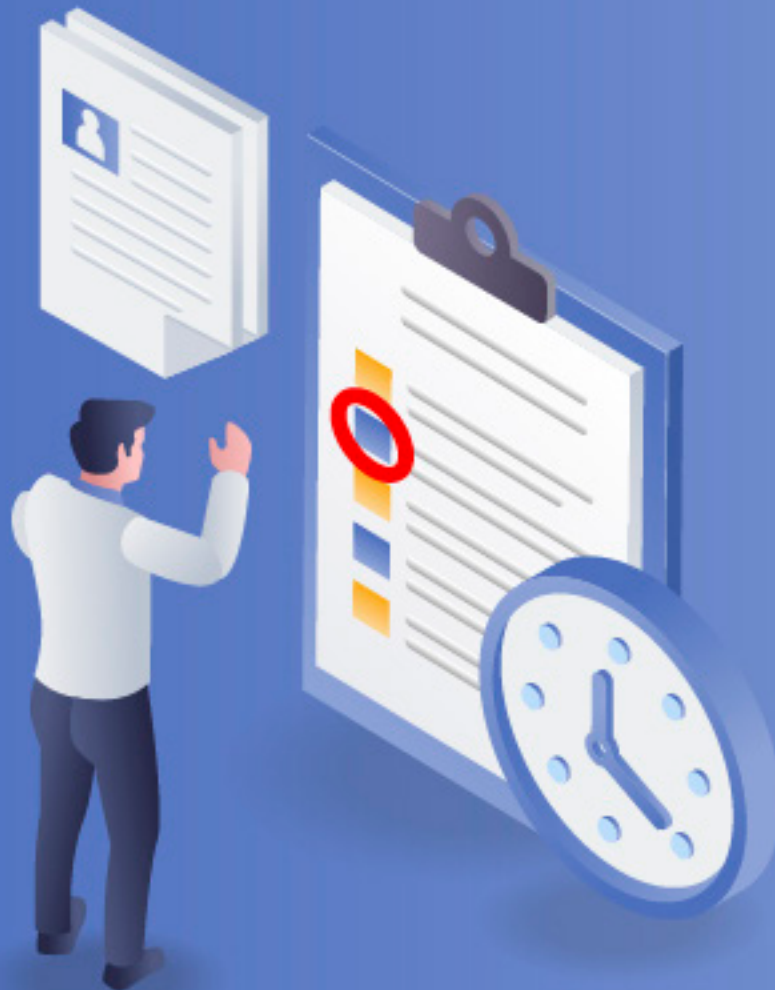




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Emerging Technologies and the Future of National Development Planning

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ABSTRACT

This study examines the benefits and challenges of leveraging emerging technologies into the national development plans (NDPs) of Sub-Saharan Africa (SSA) and similar developing countries. Employing both the systematic literature review and case study approaches, the study finds that the main challenges SSA countries face in leveraging emerging technologies in NDPs include, among others, policy and regulatory rigidities, ICT infrastructure gaps and human capacity and skills challenges. To mitigate these challenges, the study proposes that developing countries in general and SSA countries in particular should: develop national ICT and geospatial information policies, create a platform to position respective SSA countries to respond to the opportunities and challenges of leveraging emerging technologies, establish a high-level national collaborative platform, strengthen human and organizational ICT capacity, among others. The study proposes a national development plan framework (NDPF) as a template for SSA governments to effectively leverage emerging technologies. The proposed NDPF adopts a bottom-up approach to leveraging emerging technologies in national development planning to optimise the achievement of national development plans' objectives, including inclusivity, sustainability, and socio-economic development.

INTRODUCTION

This study examines the potential benefits of integrating or leveraging emerging technologies into national development plans (NDPs). National Development Plans (NDPs) are critical instruments for shaping a nation's future (UNDP, 2019). NDPs guide policy decisions, resource allocation, and track progress towards defined national priorities and goals, including the attainment of Sustainable Development Goals (SDGs). However, the rapidly evolving technological landscape presents both challenges and opportunities for NDP processes. This paper evaluates the challenges and opportunities of leveraging emerging technologies in NDPs, with a special focus on Sub-Saharan African (SSA) countries. Using technological data collection tools has become essential for nations to design national development planning frameworks (NDPFs) commensurate with the needs and demands of the ever-evolving technological and digital economies of the 21st century. The NDPFs function as comprehensive roadmaps that direct a country's socioeconomic development over predetermined timeframes (UNDP, 2019; Yang *et al.*, 2021). The literature suggests that mobile data collection tools, such as the Open Data Kit (ODK), facilitate the capture of real-time data, particularly in remote areas. This enhances data accuracy and timeliness. The use of technology in data collection for developing NDPFs leverages mobile devices to streamline field surveys. Incorporating technological tools ensures data integrity from collection to analysis (Chen & Popovich, 2018; Kjeldsted & Br  el, 2018; UNESCO, 2022). Chen and Popovich (2018) explained that improving data-collection methods for NDPFs requires significant integration with

Geographic Information Systems (GIS). Additionally, online survey platforms such as SurveyMonkey, Google Forms, and Qualtrics have proven useful for data collection in national development planning. Their ease of use enables the rapid creation and distribution of surveys to large populations, thereby gathering public opinion and specific demographic data critical for identifying development needs (Chevallier, 2014; Parolin *et al.*, 2024). These platforms often include data analysis and visualisation features, enabling planners to better understand the information collected (Mahmoud, 2018; Yang *et al.*, 2021).

However, despite the foregoing potential benefits of leveraging technologies in crafting national development plans, the national governments in Sub-Saharan Africa (SSA) seem stuck to the traditional top-down NDP processes, which are often criticized for being exclusionary because of limited citizen participation and engagement and not being data-driven (Heeks, 2018; Heeks, 2021). This implies that the lack of real-time data on progress in implementing NDPs hinders effective monitoring and evaluation of NDPs (Heeks, 2021; Udoh, 2022). By and large, traditional NDP processes do not adequately reflect diverse community needs (Udoh, 2022). Additionally, traditional top-down NDP processes are criticized for being inefficient and slow. Siloed processes and manual data analysis tend to limit agility and responsiveness to changing circumstances (World Bank, 2020). Some Sub-Saharan Africa (SSA) countries, such as Kenya, Rwanda, and Zambia, have made some headway in enhancing citizen participation in the NDP development process through the creation of the National Planning and Budgeting Policy and Act. However, many of

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the data collection methods used are manual and rely less on technology (GRZ, 2014; GRZ, 2020). Given these weaknesses in traditional NDP processes, it was necessary to investigate the potential of integrating or leveraging new technologies into NDP formulation and implementation from the SSA perspective. Integrating new technologies into NDP processes holds significant potential for improving inclusivity, efficiency, and effectiveness (World Bank, 2020; Udoh, 2022). Therefore, this study explores these possibilities through a proposed framework for the effective integration of technology in NDP in SSA countries. Leveraging technology in NDP promises to enhance both transparency and accountability, limiting populism in NDP and clientelism in public policies to achieve fair and prudent resource management. Often, this is tracked and achieved through the Monitoring, Evaluation, and Accountability (MEA) function in governance. We envision that this study will provide policymakers and development practitioners with valuable insights on leveraging the power of technology to build a better future through inclusive, efficient, and effective National Development Plans (NDPs).

This study focuses on evaluating how leveraging emerging technologies impacts National Development Planning (NDP) in achieving key objectives, such as inclusivity, sustainability, and socio-economic growth, in Sub-Saharan Africa (SSA). It seeks to identify optimal strategies for using these technologies in NDP data collection, storage, and analysis; explore approaches to boost citizen participation and inclusion during NDP development and implementation; uncover success factors for their effective integration; and assess associated risks, challenges, and ethical considerations.

LITERATURE REVIEW

This section examines the existing literature on the use of technology in development planning and governance to provide insights for assessing a country's readiness to leverage technology in NDP. Additionally, we consider case studies as examples of technology adoption in NDP for SSA countries. We review integrated development plans and policies from across the globe, as well as from different SSA countries, and strategic plans for the adoption of emerging technology in NDPs. This highlights the different ways of leveraging technology in NDPs (Admos, *et al.*, 2019; World Bank, 2020; Avtar, 2022).

Theoretical Framework

Over time, several national development theories (NDT) have emerged. Each theory offers insights into the process of national development planning. NDT can be loosely defined as a set of socio-political and economic strategies designed to enhance a nation's standard of living and economic health. This includes improving infrastructure, healthcare, education quality, and social security (World Bank, 2022; Heeks, 2021; Udoh, 2022). This section outlines theories that underpin the design

and exploitation of emerging technologies in countries in the SSA region and similar developing countries.

Rational Planning Model (RPM)

The rational planning model (RPM), also known as the rational comprehension model (RCM), is a multi-step, systematic approach to planning that emphasises a comprehensive, methodical decision-making process. RPM theory is rooted in rationality. It aims to ensure that decisions are made contingent on thorough data analysis and logical reasoning. Anderson (1979) developed this theory and outlined five basic logical steps of the model: problem definition, which involves identifying and clearly defining the problem. This is followed by a collection of relevant data, which informs the development of a range of alternatives. The third step involves evaluating alternatives and subsequently selecting the most suitable one. Implementation, as the fourth step, follows the selection of suitable alternatives and allocation of resources or budgeting. The fifth step is monitoring and evaluation. This step entails assessing the outcomes and the impact of the implemented solution. However, critics contend that what is portrayed as "public interest" in the RCM actually represents the interests of the privileged. For instance, Schon (1982) argued that due to limited time and resources, it is impossible to implement the model's comprehensiveness. However, despite these criticisms, the RCM is one of the most practical and apt models for the contemporary process of designing national development plans, as it not only draws on rational scientific reasoning but also incorporates modern technology and increased data collection (Milroy, 1991).

Collaborative Planning Theory (CPT)

The Collaborative Planning Theory (CPT) was developed by Foster (1989) to address the limitations of traditional, top-down planning approaches. This theory advocates a participatory approach, in which planners and stakeholders collaborate to create and implement plans. The theory focuses on cooperation and shared decision-making. CPT aims to enhance planning outcomes by incorporating diverse perspectives, improving legitimacy, and fostering community ownership and commitment. According to the CPT, the planning process involves stakeholder identification, which entails identifying all relevant stakeholders and understanding their interests and concerns. The engagement stage follows the stakeholder identification. The engagement stage involves creating opportunities for meaningful stakeholder participation and dialogue. The third stage is consensus building. It involves discussions to build consensus and address conflicts. The fourth stage is the implementation of the NDP. It involves developing and implementing plans that reflect the agreed-upon solutions. The fifth and final stage in the CPT model is the evaluation stage, which involves assessing the outcomes and processes to ensure that the goals of the collaboration are met and making adjustments where necessary. However, critics argue that

ensuring that the process is adequately resourced and that the needs of all stakeholders are considered is a complex procedure (Healey, 1989; HeInnes & Booher, 2018). Despite the foregoing criticisms, CPT remains applicable in sectoral, industrial, and national planning processes.

Technological Determinism

This theory posits that technological advancements drive social and economic change. It suggests that the adoption of technology can accelerate development by increasing productivity and efficiency (NEPAD, 2021; Makoza & Chigona, 2013).

Innovation Systems Theory

This theory emphasises the significance of innovation systems in fostering economic growth and development.

It suggests that technology can foster innovation by providing new tools and platforms for collaboration and knowledge sharing (Makoza, 2019).

Digital Divide Theory

This theory emphasises the need to bridge the gap between those with access to technology and those without. It suggests that technology can help reduce poverty and inequality by providing equal access to information and opportunities (UNCTAD, 2006).

Conceptual Framework

Conceptually, the study takes the national development plan frameworks (NDPFs) as the dependent variable. This is the final outcome of the national development plan processes. The PESTEL factors encompass the

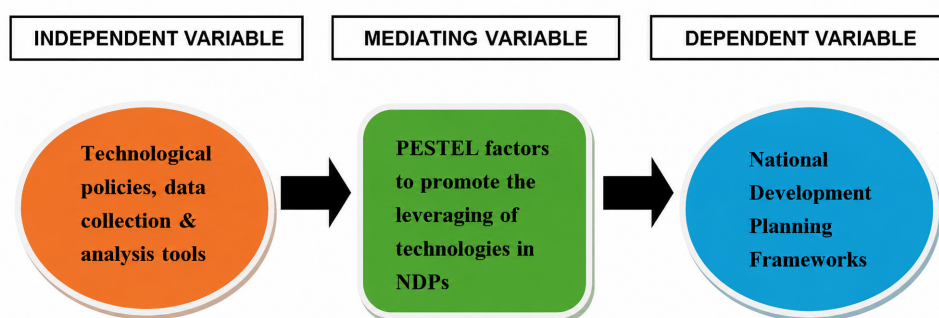


Figure 1: Conceptual Framework

political, economic, social, technological, environmental, and legal conditions necessary for the smooth integration of ICTs in NDPs, which serve as mediating variables. Technological policies, data collection, and data analytical tools are independent variables.

Operational Definition of Key Concepts

NDPFs are roadmaps that guide a country's sustained socioeconomic development over predetermined time frames. They serve as a means to achieve national social, economic, political, and cultural objectives (UNDP, 2019; Yang *et al.*, 2021).

Technological Policies, Data Collection, and Analysis Tools include digital data collection tools such as Open Data Kit (ODK), Geographic Information Systems (GIS), SurveyMonkey, Google Forms, Qualtrics, and social media platforms, among others. The use of technology in data collection for developing NDPFs leverages mobile devices to streamline field surveys. This enhances data accuracy and timeliness. Incorporating technological tools ensures data integrity from collection to analysis (Chen & Popovich, 2018; Kjeldsted & Br  el, 2018;). Chen and Popovich (2018) explain that improving the methods for gathering data for NDPFs requires significant integration of ICTs into NDP processes.

PESTEL factors after include regulatory, social, legal, and economic policies or processes that facilitate the development of ICT infrastructure and the design

of people-centred, NDP frameworks. This includes monitoring and evaluation of the implementation of the NDPs (OECD, 2019; UNESCO, 2022).

Empirical Review of Related Literature

A study was conducted by Ecuru *et al.* (2011) regarding the integration of science, technology, and innovation (STI) in national development planning (NDP), using Uganda as a case study. The study employs a systematic retrospective literature review approach. A desk review of national development frameworks, including the various national development plans and the national STI policy, was conducted. Additionally, reports from STI regional and international meetings were analysed. The study found that integrating technology into national development plans is possible through both endogenous and exogenous approaches, and that leveraging technology in NDP is a process, not a single event. The authors assert that the implementation of, and integration of technologies in national development plans should be undertaken in the context of national innovation, not sector-wise, and that the successful integration of technology in NDP should largely factor in more home-grown strategies. They contend further that while exogenous/external influences are important, on their own, they may not be effective in delivering the desired results in leveraging technological advantages in NDPs.

Parolin *et al.* (2024) conducted a study on how technology

assessment tools can be utilised in the early design stages and the crucial role technologies play in integrating sustainability into development plans. They employ a systematic review approach. They advise that when evaluating how technology is leveraged in multinational or country-level contexts, the use of leading indicators as opposed to lagging indicators, employing multiple metrics as opposed to single metrics, use of qualitative indicators instead of quantitative ones, use of simple matrix or scoring methods, and use of real data instead of proxies or estimates should be applied. The study argues that this approach should be adopted to assess technological adoption in highly uncertain, data-scarce jurisdictions (such as the SSA region), as existing ‘standard’ tools and methods may be difficult to use in such environments.

Khinnithuck *et al.* (2023) conducted a study on the role of large-scale infrastructure projects in facilitating technological transfer and vocational skills development, using the China–Laos Railway as a case study. They employ a qualitative research design, drawing on policy document analysis, Technical, Vocational and Entrepreneurial Training TVET training frameworks, and stakeholder perspectives. The study finds that the railway has enhanced technical skills in Lao PDR through structured vocational programmes, joint training with Chinese experts, and the establishment of specialised institutions such as the Lao Railway Vocational Technical College. The authors highlight gains in employability and industry-specific competencies, but caution against overreliance on foreign technology and insufficient domestic capacity-building. They argue that adaptive vocational education and technology transfer policies are necessary to ensure sustainable skills development and long-term integration into regional economies.

Virtudes and Sa (2017) developed a technology management process framework focusing on high-volume manufacturing multinational companies. Employing an ‘action research industry case study approach which includes a high-level strategic overview aimed at developing practical development of improvement plans to the existing frameworks. Five (5) generic processes of the technology framework include (i) the identification of technologies which may or may not be relevant, (ii) the selection of technologies which should be supported by the organization (or government), (iii) the acquisition and domestication of the chosen technological tools, (iv) application or exploitation of technologies to derive the benefits and (v) protection of the knowledge and expertise for the sustainability of the framework.

Sumbumbu and Okanga (2016) conducted a study on the effectiveness of national development plan implementation frameworks in South Africa. The study employed a meta-synthesis of theories on NDPs and case study methodologies with a view to recommending appropriate models for national development models. Through the meta-synthesis analysis, the study found that the success of NDP implementation was contingent on the effective use of six steps, namely environmental

analysis, outline of the vision and mission, identification of critical targets and indicators, outline of the strategic actions, implementation and monitoring and evaluation of the NDP frameworks. The study stressed the need to integrate the six steps in the NDP framework with critical success factors which, inter alia, include investment, transformational leadership, good governance, municipal capacity building and effective financial risk management. However, this study did not account for leveraging technology in NDP, which is the focus of this study.

Sabah (2013) conducted a study on the use of information and communication technology in national development planning. The study adopted the case study and systematic review approaches and asserted that an incongruity exists between the need to leverage ICTs in NDPs and government investment in ICT infrastructure, and the lack of awareness among citizens, especially those at the grassroots level, of how to address the digital divide. The study proposes a bottom-up approach to designing NDP, taking into consideration three key areas: basic needs, empowerment and rural-based development. The paper proposes a “bottom-up” approach in the use of ICTs in designing and implementing NDPs, stressing the people-centred NDP framework as opposed to a technology-centred approach, which does not factor in the needs of the citizens. The study contends that the bottom-up approach to leveraging ICT has the potential to realign misdirected development plans toward shared goals and objectives among planners, implementers, and citizens.

Ambali (2018) investigated the policy implications and recommendations for leveraging technology in the public sector (e-government). The author discusses the increasing complexity of technological advancements and organisations, and how this is affecting the interface between governments and their citizens. While cognizant of the risks associated with technology in governance, Ambali (2018) asserted that the use of ICT in the public sector enhances integration and coordination between governments and citizens, particularly in planning and service delivery.

Ernest (2023) conducted a study assessing the contribution of geospatial technology to crime prediction, focusing on burglary and robbery incidents in Kinondoni District, Dar es Salaam. The study employs a quantitative methodological approach, integrating probability and non-probability sampling alongside participatory mapping, remote sensing, GPS surveys, document review, and direct observation. Using ArcGIS-based tools such as hotspot mapping and kernel density estimation, the findings reveal distinct spatial crime patterns and identify areas with both current and projected high crime risk. The results further indicate that socio-economic factors, particularly occupation status and income levels, are significant determinants of burglary and robbery occurrences. The study highlights the policy relevance of geospatial technologies in urban crime prevention, emphasizing their value for evidence-based policing, targeted interventions, and proactive urban security

planning.

Technological Data Collection Tools for NDP Frameworks

Using technological data-collection tools has become essential for nations seeking to create National Development Planning Frameworks (NDPFs) that meet the needs of the modern world. These frameworks function as comprehensive roadmaps that direct a country's socioeconomic development over predetermined timeframes (UNDP, 2019; Yang *et al.*, 2021).

The literature posits that mobile data collection tools, including the Open Data Kit (ODK) and social media platforms, enable real-time data capture, especially in remote areas. This enhances data accuracy and timeliness. The use of technology in data collection for developing NDPFs leverages mobile devices to streamline field surveys. Incorporating technological tools ensures data integrity from collection to analysis (Chen & Popovich, 2018; Kjeldsted & Br  l, 2018). Chen and Popovich (2018) explain that improving data-collection methods for NDPFs requires significant integration with Geographic Information Systems (GIS). GIS's ability to facilitate spatial analysis and mapping makes it easier to examine geographical differences in development indicators. Unprecedented opportunities for NDPF data synthesis and predictive modelling are provided by big data analytics and artificial intelligence (AI). Large-scale datasets can be quickly analysed by AI algorithms, which can then find patterns and correlations to help with evidence-based policymaking (Wunsch-Vincent & Vickery, 2017). Large-scale data processing is enabled by big data platforms such as Hadoop and Spark, which facilitate comprehensive NDPF assessments across a variety of industries (Yang *et al.*, 2021). Additionally, online survey platforms such as SurveyMonkey, Google Forms, and Qualtrics have proven useful for data collection in national development planning. Their ease of use enables the rapid creation and distribution of surveys to large populations, thereby gathering public opinion and specific demographic data critical for identifying development needs (Chevallier, 2014). These platforms often include data analysis and visualisation features, enabling planners to better understand the information collected (Mahmoud, 2018). Brandon (2021) asserts that mobile app technology is a gamechanger for data collection, especially in geographically dispersed areas with limited internet connectivity. The use of custom-designed mobile apps can empower field workers or data collection agents in real time. This includes data collection via GPS and household surveys, among others. The use of mobile apps for data collection ensures comprehensive coverage of critical areas, such as infrastructure development and social service delivery (Rasul & Rahman, 2020). Terry (2021) explained that social listening tools, such as Brandwatch and Sprout Social, can help harvest and analyse data from social media platforms. By analysing social media data, valuable insights can be gained into public sentiment,

emerging trends, and specific topics of interest related to the development goals. By leveraging online data, planners can develop national development plans (NDPs) that address the needs and aspirations of citizens in respective countries. Furthermore, advanced data analysis tools, combined with Geographic Information Systems (GIS) software, enable the visualisation and interpretation of geospatial data, providing insights into land use patterns, environmental changes, and infrastructure development (Radu, 2021). Crowdsourcing platforms enable the collection of large datasets at a cost-effective rate compared to traditional methods, which can be difficult and/or expensive. Haklay *et.al* (2018) advise that citizen science initiatives augmented by platforms in the likes of Zooniverse and eBird empower and equip the public to be able to contribute valuable data on various thematic topics related to national development goals, such as data gathering, public health surveillance, biodiversity and climate change, among others.

Choosing Suitable Emerging Technological Tools

Technology empowers national development planners with a diverse toolkit for data collection. By leveraging online surveys, mobile apps, big data analytics, geospatial information systems, and citizen science platforms, planners can gather comprehensive and timely data to inform evidence-based development strategies. The most suitable data collection tool for a national development planning framework depends on several factors. Planners must consider the specific data required, the target population, budget constraints, and existing technological infrastructure (Ajeigbe & Salami, 2017). A combination of different tools might be necessary to achieve a comprehensive data collection strategy. Careful consideration of the specific needs, ethical implications, and data quality is essential for maximising the effectiveness of these technological tools in the pursuit of national development goals. Transparency and robust data governance practices are essential for maintaining public trust in the data collection process (Radu, 2021).

Data Analysis for Designing and Launching NDPs

Effective NDPFs rely on robust data analysis to identify development priorities, set realistic goals, and allocate resources efficiently (Ahlert *et al.*, 2016). Data analysis is fundamental to crafting robust, evidence-based NDPFs. By leveraging traditional and emerging new (big) data analysis techniques, planners can gain deeper insights into development challenges, allocate resources efficiently, and track progress towards national goals. As technology continues to evolve, integrating new data sources and advanced analytical tools (including AI tools) can further strengthen the development planning process (Brandon, 2021). Technology-driven data analysis plays a multifaceted role in crafting NDPFs. First, it informs the identification of development challenges and opportunities. Large-scale datasets on demographics, poverty rates, health indicators, and environmental conditions can reveal areas requiring

targeted intervention (Smith, 2018). Second, data analysis helps set specific, measurable goals. By analyzing trends and baselines, planners can establish realistic targets for development indicators (UNDESA, 2021). Third, data analysis underpins resource allocation decisions. Economic modelling and cost-benefit analyses can help identify the most efficient use of resources for achieving development objectives (De Haan & Rossi, 2010). Finally, data analysis is crucial for monitoring and evaluation (M&Es). Tracking progress toward NDPF goals through key performance indicators (KPIs) allows for course correction and adaptation of strategies (Udoh, *et al.*, 2022). Several data analysis techniques contribute to the construction of effective NDPFs. Statistical analysis of socioeconomic data provides insights into population growth, income distribution, and education levels (Ahlert *et al.*, 2016). Spatial analysis utilizing Geographic Information Systems (GIS) helps visualize development needs across regions and identify spatial inequalities (Terry, 2021). Furthermore, big data analysis offers unprecedented potential for NDPF development. By harnessing large datasets from sources like social media, mobile phone records, and satellite imagery, planners can gain real-time insights into citizen needs and track development progress at a granular level (Ajeigbe & Salami, 2017).

Challenges of incorporating Emerging Technologies in NDPs

Despite the benefits of using technology data collection tools, they also have drawbacks. For example, the collection of sensitive data using technological tools raises privacy concerns, which calls for strong data protection protocols (Rasul & Rahman, 2020). Furthermore, accessibility problems brought about by the digital divide restrict the applicability of technology-driven data collection in underprivileged communities such as the SSA region (UNESCO, 2020). Furthermore, the widespread adoption of cutting-edge data collection technologies is hampered by the lack of infrastructure and the need for technical expertise in developing nations (Akinyemi *et al.*, 2019). Ajeigbe and Salami (2017) assert that the success of national development planning frameworks (NDPFs) is dependent on access to accurate and comprehensive data. Traditional data collection methods, while valuable, can be time and resource intensive. However, technological advancements provide a diverse toolkit for efficient and insightful data collection, resulting in more informed development strategies. Technology data collection tools are critical for creating comprehensive NDPFs that enable informed decision-making and effective resource allocation (Rasul & Rahman, 2020). While advancements in GIS, mobile data collection, and AI offer significant opportunities, addressing privacy concerns, bridging the digital divide, and improving technical capacity remain critical challenges, especially in developing countries such

as those in sub-Saharan Africa (SSA).

Integration of Emerging and Geospatial Technologies in NDP Frameworks

Information and Communication Technology (ICT) and emerging technologies are arguably among the breakthroughs in addressing multiple global communication challenges. ICT has demonstrated its potential in improving access to financial and health services and markets in Africa through such platforms as mobile money and other interactive mobile services in Africa in general and sub-Saharan Africa (SSA) in particular. Despite this progress, the spread of ICT integration in National Development Plans in most SSA countries has been relatively low (Bilali, 2018; UNESCO, 2020).

The African Action Plan on Global Geospatial Information Management (2016-2030) emphasises the need for a common framework and tools, capacity development, and international coordination to harness geospatial information for sustainable development. This plan is aligned with the United Nations 2030 Agenda for Sustainable Development and the African Union Agenda 2063 (UNCTAD, 2006; NEPAD, 2021). The United Nations Satellite Centre (UNOSAT) is also working to strengthen capacities in the use of geospatial information technologies for improved resilience in the Asia-Pacific and Africa. This effort is part of the broader goal to accelerate the implementation of the Sustainable Development Goals (SDGs). These initiatives are working to enhance capacities for the use of geospatial information technologies to improve resilience in Africa by supporting national development plans and leveraging geospatial information for sustainable development.

There are a number of countries in Africa where emerging and Geospatial data have been integrated into their national development plans. These include Rwanda, Kenya, Egypt, Morocco, Tanzania, Mauritius, Botswana, Madagascar, South Africa and Zambia, among others.

In Uganda, for example, over the past several decades, geospatial technologies, as a set of tools and methods used in acquiring, managing, interpreting, integrating, displaying, and analysing data in the geographic, temporal, and spatial contexts, have gained increasing importance in both the public and private sectors. They include Geographic Information Systems (GIS), remote sensing, surveying techniques, and Global Positioning Systems (GPS). These technologies have been used to help store and manage land records, locate public and private facilities, and manage transportation systems and promote and protect human health (Malone, Palmer and Voigt, 2002; Ofori-Amoah, 2004; Ofori-Amoah, 2008).

In South Africa, the White Paper on Science, Technology, and Innovation emphasises the importance of collaborative planning to drive the digital society, create jobs, modernise local government services, and prioritise cybersecurity resilience using ICT and big data at the local

government level (RSA, 2019).

The African Action Plan on Global Geospatial Information Management (AAPGGIM) focuses on governance, policy, capacity development, and international coordination to harness geospatial information for sustainable development in Africa. It highlights the integration of geospatial information and statistics as a key area for providing decision-makers with sound information products and services aligned with the African Union Agenda 2063 objectives (United Nations Economic Commission for Africa, UNECA, 2017; NEPAD, 2021). In Zambia Planners have successfully utilized geospatial solutions to inform integrated development plans, addressing key development challenges and service gap (Shafika, 2007). In Nigeria, agricultural information dissemination suggests that the country's NDP may aim to address ICT challenges by leveraging emerging and geospatial data in the agricultural sector. These examples demonstrate how the integration of emerging is being successfully implemented in national development plans across Africa, showcasing the potential for these technologies to drive sustainable development and address key challenges in various sectors.

MATERIALS AND METHODS

Methodologically, we follow Ecuru et. al (2011) and Parolin *et al.* (2024) in applying systematic literature review and case study approaches. The rationale for using both approaches is that a systematic literature review allows us to gather, evaluate and synthesize existing knowledge on national development planning (Sabah, 2013; Parolin *et al.*, 2024). The rationale for using case studies approaches is that they provide detailed, context-specific insights into national development planning processes. In addition,

case studies provide practical, specific, and in-depth examples of how countries have successfully leveraged technology in their national development planning processes (Ecuru *et al.*, 2011; Sumbumbu & Okanga, 2016). In summary, a systematic literature review helped us to anchor our research in existing knowledge and theory, whereas case studies provided us with detailed, practical insights necessary for understanding the complexities of development planning in different contexts.

Search Strategy: Inclusion & Exclusion Criteria

The systematic review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) methodology (Page *et al.*, 2021). A comprehensive search using phrases such as “Leveraging technology in NDP processes”, “Countries that have incorporated new technologies such as social media online digital dashboards in national development planning processes”, “Mobile data collection tools for national development planning” and related keywords such as “Open Data Kit”, “Geographic Information Systems”, “Online survey platforms such as Survey Monkey, Google Forms, and Qualtrics” was done on eight (8) multidisciplinary journal databases: Web of Science (WOS), Scopus, Google Scholar, Science Direct, EBSCOhost, Wiley Online Library, SpringerLink and Emerald Insight.

The articles included were those that satisfied the following pre-defined eligibility criteria: (i) were peer-reviewed, Open Access (OA) and published between 2000 and 2024 from across the globe, (ii) Full length and published in English (iii) appeared in multidisciplinary social journals indexed by the Social Sciences Citation Index (iv) directly related to leveraging or integration of

Table 1: Results after Initial Article Search-2000-2024

Database	No. of articles	Aggregation of articles by Region
Web of Science (WOS)	51	25 focused on Europe, 9 on the USA, 8 on Asia, 4 on South America, 3 on MENA, and 2 on SSA.
Scopus	30	13 focused on Europe, 7 on the USA, 2 on MENA, 4 on Asia, 2 on South America, and 2 on SSA
Google Scholar	43	11 on the USA, 10 focused on Europe, 8 on MENA, 8 on Asia, 3 on South America, and 3 on SSA.
Science Direct	14	4 on the USA, 3 focused on Europe, 2 on MENA, 3 on Asia, 1 on South America, and 1 on SSA
EBSCOhost	39	13 focused on Europe, 9 on the USA, 7 on Asia, 6 on South America, 3 on MENA, and 1 on SSA
Wiley Online Library	11	4 focused on Europe, 2 on the USA, 3 on Asia, 1 on South America, 1 on MENA, and 0 on SSA
SpringerLink	9	3 focused on the USA, 2 on Europe, 2 on Asia, 2 on South America, 0 on MENA, and 0 on SSA
Emerald Insight	16	4 focused on Europe, 3 on the USA, 3 on Asia, 1 on South America, 2 on MENA, and 3 on SSA
Total	213	

ICT in NDP processes while excluding research notes, editorial comments. Conference-refereed papers were included. Our search was conducted between May 7 and June 26, 2024. After the initial search, retrieved articles were screened by title, abstract, and keywords. The full-

text review was conducted based on the inclusion and exclusion criteria.

From Table 1, it is easy to observe that Europe seems to have had the lion's share of articles potentially focusing on how technology is leveraged in NDPs, at 74, followed

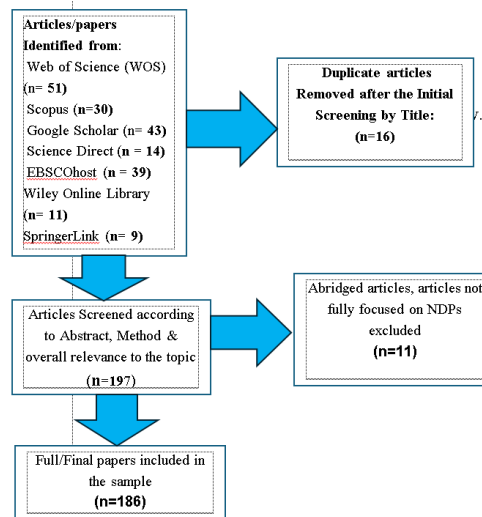


Figure 3: Flow Chart of Article Selection Process.

Table 2: Summary of the results of the Article Screening Process

Region	USA	Asia	Asia	MENA	South America	SSA
Number of Articles in the initial article search (n=213)	74	48	38	21	20	12
Number of Articles in the final sample (n=186)	68	43	32	15	16	12

by the United States at 48, Asia at 38, MENA at 21, South America at 20, and SSA at 12.

The flow chart in Figure 3 shows the final selection process of the articles after further screening processes. The full papers included in the sample reduced

from 213 to 186 after the screening. Table 2 summarizes the outcome of the flow chart in Figure 3.

RESULTS AND DISCUSSIONS

Findings from the Systematic Literature Review

From the systematic review of the 12 articles focusing on the SSA countries and other related articles, this study unravelled the following challenges SSA countries face in leveraging emerging technologies in NDP frameworks:

Policy and regulatory challenges: Many developing countries, in general, and SSA countries, in particular, lack clear and operational ICT policies, with inadequate support from governments and insufficient funding to execute the policies. This leads to a lack of coordination and oversight in emerging technologies implementation in NDP frameworks. (Udoh *et al.*, 2021; Ntorukiri, Kirugua & Kirimi, 2022).

ICT Infrastructure challenges: SSA countries often face shortages of critical ICT infrastructure such as computers, network connectivity, and technical support for users. This is a major hindrance to effective emerging implementation (Radu, 2021; Ntorukiri, Kirugua & Kirimi, 2022).

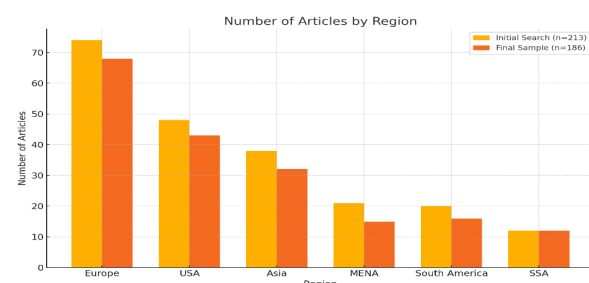


Figure 2: Changes between the Initial and Final Article Selection Process

Capacity and skills challenges: The general citizens of the SSA countries frequently lack digital skills and knowledge and insufficient training and professional development opportunities and digital divide. (Ajeigbe & Salami, 2017; Rasul & Rahman, 2020).

Resistance to change: Some stakeholders may be resistant to adopting emerging ICT policies and integrating technology into their work due to negative attitudes or a lack of awareness about the benefits. Overcoming this cultural resistance is crucial for successful implementation and leveraging of emerging technologies in NDP frameworks (Bilali, 2018; Makoza, 2019).

Coordination and collaboration challenges: Effective ICT implementation often requires coordination and collaboration across different government agencies, the private sector, and civil society. This seems to be lacking in many SSA countries. (Makoza & Chigona, 2013, Bhatnagar, 2014; Akinyemi *et al.* 2019; RSA, 2019)

Budgetary Limitations: Lack of adequate budgetary allocation to ICT infrastructure development, professional training and digital skills development hinder the implementation of and leveraging of emerging technologies in NDP frameworks (Sumbumbu & Okanga, 2016; Ntorukiri, Kirugua & Kirimi, 2022).

Key Factors for Effective Integration of Emerging Technologies in NDPs

To mitigate the foregoing challenges and ensure that national governments in SSA and other developing countries effectively leverage ICT in their NDPs, we propose the following strategies gleaned from the literature:

Develop/strengthen a National ICT and Geospatial Information Policy: SSA governments should establish a policy that promotes easy access to emerging technologies tools and geospatial information products and services and should facilitate collaboration and innovation (RSA, 2019; United Nations Economic and Social Council, 2016).

Establish a High-Level National Collaborative Platform: Create a platform to position respective SSA countries to respond to the opportunities and risks flowing from the integration of emerging technologies such as artificial intelligence (AI) in contributing to the development of NDPs (Ajeigbe & Salami, 2017; Ntorukiri, Kirugua & Kirimi, 2022).

Strengthen Human and Organizational Capacity: SSA governments should focus on continuous capacity building through training programs and research initiatives to sustain long-term capacity building in technical skills related to emerging technologies, including AI and geospatial technologies to ensure the sustainability of geospatial technologies in national development plans (Stiglitz *et al.*, 2000; Mwange, 2017).

Establish a Common ICT Framework & Collaborate with International Partners: SSA governments should develop or strengthen the existing ICT framework and digital data collection tools for producing, managing,

disseminating, and using spatial data to ensure effective integration of emerging technologies and geospatial tools to integrate geospatial information and statistics in national development plans. This will provide decision-makers with sound information products and services aligned with sustainable development goals and national development objectives. Additionally, SSA governments should continue to participate in global ICT initiatives, such as the United Nations Global Geospatial Information Management (UN-GGIM), to leverage international coordination and cooperation. (Ofori-Amoah, 2008; United Nations Economic and Social Council, 2016; United Nations Economic Commission for Africa, UNECA, 2017; Parolin *et al.*, 2024)

Leverage Open-Source Software: Developing countries in the African region and other developing countries should utilize open-source software like Quantum GIS to enhance the capacity of technical personnel and facilitate planning as well as data collection and analysis activities. (United Nations Economic and Social Council, UNESCO, 2016; Akinyemi *et al.*, 2019)

Prioritize Cybersecurity Resilience: SSA and similar developing country governments should ensure that national development plans prioritize cybersecurity resilience to protect geospatial information and ICT infrastructure from cyber threats (Udoh, *et al.*, 2022).

Selected Case Studies

This section presents case studies from around the world on leveraging emerging technology in NDPs. There is a growing trend worldwide of governments applying digital tools and

e-government systems predicated on the belief that leveraging emerging technologies in national development strategies enhances governments' delivery of socio-services, increases citizens' engagement in governance issues, and generally improves public sector efficiency, transparency, and accountability (Mpinganjira, 2018; Brandon, 2021; Udoh, 2022). Table 3 provides a summary of the diverse approaches' national governments from around the world have used and continue to use to leverage emerging technologies in their NDPs. From the few case studies we reviewed, it is evident that while the specific strategies and outcomes may vary, the common theme is that emerging technologies have a transformative effect on digital government (e-government) in general and national development Planning (NDP) processes in particular. These case studies highlight some of the best practices that SSA and other developing countries can emulate to successfully integrate emerging technologies in their NDPs.

Proposed NDP Framework for Leveraging Emerging Technologies

The proposed NDP framework adopts a bottom-up approach to selecting emerging technological policies to be leveraged in NDPs, as the essence of development plans is to improve the welfare of citizens. Integrating

emerging technologies in NDPs must augment the attainment of socio-economic objectives centred on people (Rasul & Rahman, 2020). It is envisioned that a bottom-up approach will enable NDPs to meet the basic needs of people in each respective jurisdiction or country, digitally empowering them and thereby reducing the digital divide (Digital Agenda of Estonia, 2020).

Figure 4 presents the proposed NDP framework (NDPF) for the SSA and similar countries, given the identified gaps in the foregoing sections. From the few case studies we reviewed, it is evident that while the specific strategies and outcomes may vary, the common theme

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Table 3: Model Case Studies of Countries Leveraging Emerging Technologies in NDPs

Country/Region	Overview	Role of e-government in Development	Effect/Impact of Leveraging Technology in NDPs
Estonia (Northern Europe)	Known as a 'digital Republic' on account of the widespread integration of technology in Estonia's public service since the early 1990s (Kalvet, 2012; Digital Agenda of Estonia, 2020)	Estonia's e-government strategy centres around the X-Road platform, whereby all government databases operate in harmony. The X-platform underpins all digital services, including tax-filling and e-residency (Government of Estonia, 2023)	-The digitization of public services has improved public trust in government due to reduced corruption. Through the use of digital tools, citizen participation in national governance issues has grown exponentially by more than 40% relative to the early independence days. This includes participation in drafting and reviewing Estonia's national development plans (NDPs). Estonia has become a model in e-government best practices, especially in the European Union. -By leveraging technology in its NDPs, Estonia has transformed itself into an efficient, transparent and citizen centric government and a prosperous economy in the European Union (Government of Estonia, 2023)
South Korea (East Asia)	South Korea (SK)'s approach to successful integration of technology(e-government) in NDP started in the early 2000s to augment economic development and position itself as a global information, communication technology (ICT) leader (Korea Agency for Digital Opportunity, KADO, 2023)	SK's approach to leveraging technology in its NDPs focuses on the development and growth of ICT infrastructure, the promotion of digital literacy among the citizens and the widespread integration of digital services in all government operations (Kim & Lee, 2012)	-The launch of the SK's government of 3.0 in 2013 was revolutionary. It marked a shift towards a more open, transparent, and participatory government, emphasizing data sharing and citizen engagement. - Due to the integration of ICT in Government services and in NDPs, SK's economic growth continues to soar. The - Launch of the 3.0 initiative by the government resulted in enhanced citizen participation in governance as well as improved efficiency of public service delivery. improved public service delivery (Kim & Lee, 2012; KADO, 2023)

India (South Asia)	The larger Digital India plan, which was introduced in 2015, is closely related to India's e-government activities. The initiative seeks to establish India as a knowledge-based society and economy by utilising technology for public policy and governance. The larger Digital India plan, which was introduced in 2015, is closely related to India's e-government endeavours. Using technology in public service delivery and governance, the program seeks to turn India into a knowledge economy and society empowered by the digital age (Bhatnagar,2014; Ministry of Electronics and Information Technology, India, 2023)	India's e-government initiatives are anchored by the Aadhaar biometric identification system, which provides quick and safe access to various services. -The development of digital infrastructure, digital literacy, and the provision of digital services are some of the main elements of the Digital India initiative (Bhatnagar,2014; Ministry of Electronics and Information Technology, India, 2023)	-Economic Inclusion: By lowering leakages and boosting economic inclusion, Aadhaar has made it easier for millions of citizens to receive subsidies and benefits directly. Government Efficiency: Thanks to e-government, the delivery of public services has become more efficient, especially in rural and isolated areas. -openness: The digitisation of government operations has decreased corruption and increased openness (Ministry of Electronics and Information Technology, India, 2023)
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be leveraged in NDPs, as the essence of development plans is to improve the welfare of citizens. Integrating emerging technologies in NDPs must augment the attainment of socio-economic objectives centred on people (Rasul & Rahman, 2020). It is envisioned that a

bottom-up approach will enable NDPs to meet the basic needs of people in each respective jurisdiction or country, digitally empowering them and thereby reducing the digital divide (Digital Agenda of Estonia, 2020).

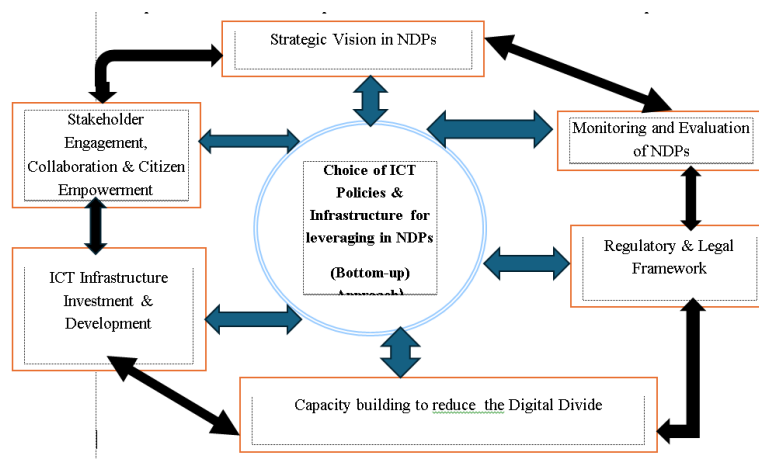


Figure 4: Proposed National Development Plan Framework for SSA & Comparable countries.

Figure 4 presents the proposed NDP framework (NDPF) for the SSA and similar countries, given the identified gaps in the literature.

Proposed National Development Plan Framework for SSA & Comparable Countries

Explaining the Components of the NDPF

The inner arrows indicate a bidirectional effect between the emerging ICT and the other factors that shape the NDP frameworks. The external arrows are also bidirectional, indicating that the six factors are not mutually exclusive.

Leveraging ICT in development planning starts with establishing a strategic vision and ensuring that it aligns with existing national technological policy, emerging new technologies, and infrastructure. Respective governments in SSA countries must develop a policy framework that clearly outlines how technology will be leveraged to achieve sustainable development (UNDP, 2020; Ntorukiri, Kirugua & Kirimi, 2022). Effective NDPFs are predicated on robust data analysis to identify development priorities, set realistic goals, and allocate resources efficiently (Ahlert *et al.*, 2016). Technology driven data analysis plays a multifaceted role in crafting NDPFs.

Stakeholder Engagement and Collaboration

Effective integration of ICT in NDPs demands that various stakeholders, including private sectors, civil society organizations (CSOs), government agencies and international partners, are engaged from design through implementation as well as monitoring and evaluation of development plans. Collaborative efforts ensure that technological initiatives are aligned with the needs of the citizens and are sustainable in the long term (Mpinganjira, 2018; OECD, 2019)

Infrastructure Development

ICT infrastructure is a crucial component of successfully integrating emerging technologies in NDPs. Without ICT infrastructural and policy development, no meaningful ICT leverage in NDPs can and will happen. SSA governments should, therefore, prioritize ICT infrastructure. This includes investments in telecommunications, data centres and energy supply systems, which are essential for the operation of existing and emerging modern technologies (Stiglitz *et al.*, 2000; World Bank, 2021). By leveraging online surveys, mobile apps, big data analytics, geospatial information systems, and citizen science platforms, planners can gather comprehensive and timely data to inform evidence-based development strategies (Ajeigbe & Salami, 2017). A combination of different tools might be necessary to achieve a comprehensive data collection and emerging technology leveraging strategy (Radu, 2021).

Capacity Building and Skill Development

For emerging technologies to be effectively leveraged in

NDPs, the SSA policymakers should focus on building the workforce's digital capacity. This involves, among other things, education and training programs that equip individuals with the skills needed to manage and utilise ICTs from data collection through to data analysis. Digital Capacity and skill development should also be extended to the general citizenry through community digital education programs, especially in rural areas. The use of social media platforms, including the Open Data Kit (ODK), enables the capture of data in real time, especially in remote areas. This enhances data accuracy and timeliness. Improving digital literacy has the potential also to improve citizen participation in governance issues. The use of social media platforms will reduce the digital divide that exists between the urban and rural areas in most developing countries in general and SSA countries in particular (Bhatnagar, 2014; Africa Development Bank, ADB, 2020).

Regulatory and Legal Frameworks

Regulatory and legal frameworks are necessary to ensure that ICTs are well leveraged in NDPs because they help manage the risks associated with the adoption of emerging new technologies, including artificial intelligence (AI). These frameworks ensure that the integration of ICTs in NDPs does not result in legal issues such as data privacy violations, cybersecurity threats or the exacerbation of inequality (UNDP, 2020; ITU, 2012; KADO, 2023)

Monitoring and Evaluation

Finally, integrating technology into NDPs requires sustained monitoring and evaluation of the NDPs to assess the impact of leveraging technology. This process helps identify areas for improvement and ensures that emerging technologies are applied effectively to meet national development goals (UNDP, 2020; UNESCO, 2022; Parolin *et al.*, 2024). Integrating emerging technologies in NDPs has the potential to improve information sharing between citizens and planning officers. Additionally, ICT promotes the swift adaptation of policies and programs to reflect citizens' needs. Leveraging ICT in NDPs also promotes efficiency in the planning process by bridging knowledge gaps and mitigating the time constraints common in traditional national planning. Data analysis is fundamental in crafting robust and evidence-based NDPFs. By leveraging traditional and emerging new (big) data analytics and advanced analytical tools such as AI tools, planners can gain deeper insights into development challenges, allocate resources efficiently, and track progress towards national goals (Brandon, 2021).

CONCLUSION

This study examines the benefits and challenges of leveraging emerging technologies into the national development plans (NDPs) of Sub-Saharan Africa (SSA) and similar developing countries. Employing both the systematic literature review and case study approaches, the study finds that the main challenges SSA countries face in

leveraging emerging technologies in NDPs include, among others, policy and regulatory rigidities, ICT infrastructure gaps and human capacity and skills challenges. To mitigate these challenges, the study proposes that developing countries in general and SSA countries in particular should: develop national ICT and geospatial information policies, create a platform to position respective SSA countries to respond to the opportunities and challenges of leveraging emerging technologies, establish a high-level national collaborative platform, strengthen human and organizational ICT capacity, among others. The study proposes a national development plan framework (NDPF) as a template for SSA governments to effectively leverage emerging technologies. The proposed NDPF adopts a bottom-up approach to leveraging emerging technologies in national development planning to optimise the achievement of national development plans' objectives, including inclusivity, sustainability, and socio-economic development.

Overall, the systematic literature review indicates that leveraging emerging technologies in the development and implementation of NDPs must begin with establishing a strategic vision, and ensuring that it aligns with existing national technological policies and ICT infrastructure. Effective integration of emerging technologies in NDPs demands that various stakeholders, such as private sector entities, civil society organizations (CSOs), government agencies and international partners are engaged from designing NDPs through implementation to monitoring and evaluation (M & E) of NDPs.

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Declaration of Conflict of Interest.

The authors declare that they have no known competing financial interests or personal relations that could influence the work reported in this paper.

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