Evaluating the Realities of SDG 11 in Africa: Achieving Urban Sustainability by 2030–Fact of Fiction?

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Abstract

This commentary critically examines the progress and challenges in achieving Sustainable Development Goal 11 (SDG 11) in Africa, which aims to make cities and human settlements inclusive, safe, resilient, and sustainable by 2030. Despite rapid urbanisation and economic growth, Africa's urban areas face significant challenges, including outdated colonial-era planning systems, high youth unemployment, and inadequate infrastructure. The persistence of informal settlements, environmental degradation, and governance issues further complicate urban development efforts. The commentary explores innovative strategies to advance SDG 11 within the remaining time frame, focusing on digital twin technology. Digital twins hold transformative potential by simulating urban scenarios, optimising resource allocation, and improving municipal operations. These computerised models replicate real-world systems, using logic, machine learning, simulation, and real-time data to support informed decision-making. These technologies can significantly improve urban planning, public safety, and service delivery, creating more resilient and sustainable urban environments on the continent. Critical components for successfully implementing sustainable cities are outlined, emphasising the importance of strategic planning, talent development, robust data infrastructure, and active collaboration between the public and private sectors. The SODPA model—Strategy and Talent, Operation and Business, Data and Infrastructure, Platform and Technology, and

Application and Scenario—provides a comprehensive framework for developing and managing digital twin cities. The commentary underscores the need for significant policy changes, increased investment in urban infrastructure, and innovative financing mechanisms to bridge the existing gaps. The conclusion calls for a concerted effort from all stakeholders to leverage technology and foster inclusive, resilient, and sustainable cities across Africa by 2030.

Keywords: SDG11; Sustainable urban development; Challenges of urbanisation; Resilient urban planning; Digital Twin Technology

Introduction

Africa faces significant economic difficulties developing livable towns and cities to attain SDG 11 *('Make cities and human settlements inclusive, safe, resilient and sustainable')* (Mangweta, Mokoel, & Monama, 2022; Nnenna, Mulegi, Mbabazi, & Esther, 2023). A major obstacle is the enduring influence of colonial-era planning systems, which many African countries still use, resulting in fragmented urban environments and urban sprawl (Monama, Mokoele, & Mokgotho, 2022).

Urbanism's complexity in Africa varies greatly and is context-dependent (Cobbinah, 2023). Despite growing research, urban planning and development challenges remain underexplored (Dodman, Leck, Rusca, & Colenbrander, 2017; Cardoso, 2016; Van Noorloos, 2018). Many African cities struggle with rapid urbanisation and inadequate planning (Cobbinah, 2023).

The demand for urban services and affordable housing is overwhelming cities in the Global South (Gebregiorgis, Namangaya, Greiving, & Kombe, 2022). Slum or informal settlement dwellers comprise over half of the urban inhabitants in cities like Addis Ababa and Dar es Salaam (Gebregiorgis, Namangaya, Greiving, & Kombe, 2022). Cities must address environmental, mobility, and waste management issues while improving housing and sanitation for over half of their population (Alem & Namangaya, 2021).

In addition, global climate change and poor urban planning significantly increase cities' likelihood and severity of flooding (Cobbinah, Poku-Boansi, & Peprah, 2017; Addaney, Boshoff, & Olutola, 2017; Addaney & Cobbinah, 2019). The layout of urban settlements, the deterioration of

green and blue infrastructure, and the limited urban management capacity all contribute to heightened flood risk (Gebregiorgis, Namangaya, Greiving, & Kombe, 2022). Moreover, informal settlements in hazardous and environmentally sensitive areas are becoming increasingly common in African urban settings, as well as in Latin America and Asia (Greiving, Du, & Puntub, 2018).

Africa is the fastest-growing continent yet the least urbanised (UN-HABITAT, 2022). The urban population has quadrupled over the past three decades, with 44% now living in cities (Wang & Kintrea, 2021; Forget, Shimoni, Gilbert, & Linard, 2021; UN-HABITAT, 2022). By 2035, half of the region's population will be city dwellers, and by 2050, six out of ten will live in urban areas. Despite predictions of a slowdown, Africa will continue to have the highest urban growth rate globally (UN-HABITAT, 2022). Rapid population growth without improved infrastructure and services negatively affects Sub-Saharan Africa (SSA) (Saghir & Santoro, 2018). Low investment, declining productivity, and negative per capita income growth persist (Saghir & Santoro, 2018). Structural changes and building local capacity for managing urbanisation are essential for long-term economic success (Saghir & Santoro, 2018).

This study assesses the progress and obstacles to achieving SDG 11 in Africa and analyses urbanisation's impact on sustainable development. It identifies economic, governance, and environmental challenges and suggests actionable plans to address these hurdles. Additionally, the study outlines a roadmap for cities to progress towards SDG 11, emphasising stakeholder involvement, pilot projects, and feedback mechanisms for sustained improvement. These guidelines aim to assist decision-makers, urban planners, and stakeholders in achieving urban development in Africa by 2030.

Urbanisation in Africa: Challenges and Opportunities

Challenges

Urbanisation in Africa is rapidly increasing, making it the fastest-growing yet least urbanised continent (UN-HABITAT, 2022). Africa's urban population growth rates are the fastest globally, at 3.17% between 2015 and 2050 (UN-HABITAT, 2022) (see Tables 1 and 2 below). For example, Nigeria's urbanisation increased from 17% in 1960 to over 50% in 2020 and

is projected to reach 68.4% by 2050 (Sakketa, 2023). This rapid urban expansion is often characterised by informal settlements, inadequate infrastructure, high unemployment, insufficient local government funding, and poor governance (van Vliet, 2019; de Bruin, Dengerink, & van Vliet, 2021; UN-HABITAT, 2022). Rising inequality, poverty, and climate change's effects further exacerbate urban challenges in SSA (UN-HABITAT, 2022). For example, South Africa, Ghana, and Kenya also exhibit high urbanisation rates but face significant challenges such as inequality, unemployment, and environmental degradation (Sakketa, 2023).

Despite the potential economic benefits, urbanisation often occurs at lower income levels and fails to increase demand for agricultural products or improve general well-being in many regions (Cordes & Morrison, 2023; Li, Yu, & Hong, 2023). Over 70% of Africa's urban population lives in slum conditions, worsening socioeconomic disparities (Sakketa, 2023). Urbanisation also leads to increased solid waste, pollution, and environmental degradation, posing significant health risks (Hoornweg, Bhada-Tata, & Kennedy, 2013; Ghosh, *et al.*, 2022). Urbanisation is also linked to increased greenhouse gas emissions, straining natural resources (Lall, Henderson, & Venables, 2017).

In addition, the persistent influence of colonial-era planning systems has resulted in urban forms incompatible with contemporary African cities' diverse needs (van Oostrum, 2024). Colonial design systems have traditionally placed a higher priority on automobile mobility than pedestrian accessibility, creating urban landscapes that hinder walkability and livelihoods that are inhospitable to the requirements of the urban poor, who mainly depend on walking for everyday commuting and rely on accessible public spaces and services (van Oostrum, 2024; Cobbinah & Finn, 2024). These systems often perpetuate spatial segregation, as seen by the lack of consideration given to indigenous knowledge systems in design, which might improve community cohesion and well-being in low-income (Billawer & Nel, 2024). This situation leads to fragmented urban environments that fail to integrate new migrants, particularly those settling in informal settlements on the urban periphery (van Oostrum, 2024). This exclusion is physical but also social, economic, and political, contributing to a growing divide between established urban residents and those seen as "outsiders" (Yeboah, 2024).

The juxtaposition of contemporary and traditional urban districts exacerbates issues of equality and liveability as Western planning frameworks fail to accommodate the unique spatial, cultural, and socioeconomic demands of African inhabitants (Ola, 2023). The reliance on these outdated frameworks has rendered cities less liveable, unable to keep pace with rapid urban expansion or provide sufficient services and amenities for all residents (Ola, 2023). Moreover, project-oriented and centralised planning methods fall short of addressing the needs of informal settlements, which are expected to house a significant portion of future urban population growth (Okyere, Frimpong, Diko, Mensah, & Pedrosa, 2023).

To tackle these challenges, urban planning in Africa must move beyond the constraints of colonial-era systems and adopt a more inclusive approach (Torabi Moghadam, 2024). This includes empowering local communities, involving them in the planning process, and developing policies that address the needs of all urban residents, particularly those who have historically been marginalised (Fadda, 2024; Okyere, Frimpong, Diko, Mensah, & Pedrosa, 2023). By doing so, cities may become more equitable, sustainable, and capable of fostering social cohesion among diverse populations (Kasusu & Chikweshe, 2024). Rethinking urban planning through this lens will enable African cities to serve the demands of their varied populations better and truly realise the goals of inclusivity as envisioned by SDG 11.

Opportunities

Nonetheless, urbanisation presents opportunities for economic growth and poverty reduction. It can create new jobs and diversify rural livelihoods, particularly in small and secondary towns (Ørtenblad, Birch-Thomsen, & Msese, 2019). For example, urbanisation has significantly reduced poverty in Tanzania, especially in the secondary cities (Christiaensen, De Weerdt, & Todo, 2013). Effective urban planning and governance can harness urbanisation to enhance economic opportunities, improve infrastructure, and support climate change adaptation (Grafakos, *et al.*, 2020). Financial connections between urban and rural areas, such as remittances, help rural communities by providing investments and overcoming cash flow problems, thus increasing agricultural production Kapri & Ghimire, 2020). Furthermore, understanding urbanisation's impact

on biodiversity and ecosystem services is crucial for achieving sustainable development and food security in urban and rural areas (Sakketa, 2023).

Table 1: Level of Urbanisation

Region	Percentage urban							
	2015	2020	2025	2030	2035	2040	2045	2050
World	53.9	56.2	58.3	60.4	62.5	64.5	66.4	68.4
More developed regions	78.1	79.1	80.2	81.4	82.7	84.0	85.4	86.6
Less developed regions	49.0	51.7	54.3	56.7	59.0	61.3	63.4	65.6
Africa	41.2	43.5	45.9	48.4	50.9	53.6	56.2	58.9
Asia	48.0	51.1	54.0	56.7	59.2	61.6	63.9	66.2
Europe	73.9	74.9	76.1	77.5	79.0	80.6	82.2	83.7
Latin America and the Caribbean	79.9	81.2	82.4	83.6	84.7	85.8	86.9	87.8
North America	81.6	82.6	83.6	84.7	85.8	86.9	88.0	89.0
Oceania	68.1	68.2	68.5	68.9	69.4	70.2	71.1	72.1

Source: (UN-HABITAT, 2022)

Table 2: Urban rate of change 2015–2050

Region	Average Annual Rate of Change of the Urban Population (per cent)							Entire Period
	2015-2020	2020-2025	2025-2030	2030-2035	2035-2040	2040-2045	2045-2050	2015-2050
World	1.90	1.73	1.58	1.45	1.33	1.22	1.13	1.48
More developed regions	0.50	0.46	0.44	0.40	0.36	0.32	0.28	0.39
Less developed regions	2.34	2.09	1.88	1.71	1.56	1.42	1.31	2.09
Africa	3.58	3.44	3.32	3.19	3.04	2.89	2.71	3.17
Asia	2.16	1.84	1.58	1.35	1.15	0.98	0.84	1.41
Europe	0.35	0.30	0.28	0.26	0.25	0.22	0.17	0.26
Latin America and the Caribbean	1.30	1.15	1.00	0.85	0.72	0.59	0.47	0.87
North America	0.95	0.96	0.92	0.84	0.75	0.67	0.62	0.82
Oceania	1.42	1.30	1.24	1.18	1.15	1.12	1.07	0.89

Source: (UN-HABITAT, 2022)

From MDG 7 to SDG 11 and the New Urban Agenda

The Millennium Development Goals (MDGs) aimed to address global issues like poverty, hunger, and environmental degradation by 2015 (World Health Organisation, 2018). Adopted in 2000, the MDGs provided a framework for international development efforts but fell short on human rights, gender equality, environmental sustainability, and economic growth (Ford, 20215).

The Johannesburg Declaration (2002) and the "The Future We Want" document (2012) led to the development of the Sustainable Development Goals (SDGs), expanding the focus to a broader range of issues. The 2030 Agenda for Sustainable Development, approved in 2015, includes 17 SDGs (United Nations, 2024).

Target 11 of MDG 7 (*'Ensure environmental sustainability'*) aimed to improve the lives of 100 million slum dwellers by 2020, highlighting slums as a critical development issue (United Nations, 2022). However, little progress was made due to the rapid pace of urbanisation and the MDGs' limited view of urban sustainability (Mangweta, Mokoel, & Monama, 2022). The Habitat Agenda inspired efforts to create sustainable human settlements and eradicate slums (Croese, Cirolia, & Graham, 2016).

The SDGs, particularly SDG 11, focus on creating inclusive, safe, resilient, and sustainable cities (Metaxas & Metaxas, 2023). The City Prosperity Initiative (CPI), introduced by UN-Habitat in 2015, aims to help governments recognise and address urban challenges using regulated methodologies and statistical analysis (Obure, *et al.*, 2019).

Neighbourhood-level improvements, including public health, affordable housing, and climate action, are crucial for achieving SDG 11 (Sharifi & Murayama, 2013). Tools like CASBEE-UD (Japan), BREEAM (UK), and LEED-ND (USA)[1] help monitor and assess sustainability

[1] These there are three internationally applicable and widely used tools which include the Comprehensive Assessment System for Built Environment Efficiency Urban Development (CASBEE – UD, Japan), the Building Research Establishment Environmental Assessment Method (BREEAM – United Kingdom), and Leadership in Energy and Environmental Design Neighbourhood Development (LEED-ND, USA) (Braulio-Gonzalo, Bovea, & Ruá, 2015).

development, promoting innovation and transparency (Braulio-Gonzalo, Bovea, & Ruá, 2015). However, these programs require thorough calculations and substantial effort (Arslan, Durak, & Aytac, 2016).

The New Urban Agenda (NUA), approved at the Habitat III conference in October 2016, is the first globally approved document outlining how the urban component of the SDGs, particularly SDG 11, would be implemented (Vaidya & Chatterji, 2020). It guides the UN system's urban interactions for the next 20 years, emphasising actions to ensure cities and human settlements serve as engines of growth (UN-Habitat, 2018).

Building on SDG 11, the NUA extends beyond Goal 11 to include a broad range of activities required to make cities spatially effective for sustainable development (UN-Habitat, 2018). It outlines strategic measures such as national urban policies, laws, spatial planning, and municipal budgets to support the realisation of SDGs (United Nations, 2017; UN-Habitat, 2018). These frameworks help integrate SDG 11 goals into local planning and governance (Vaidya & Chatterji, 2020).

The NUA represents a global effort to rethink urban systems and create a more equitable and sustainable future, recognising cities as potential solutions to global problems (United Nations, 2017). It presents a paradigm shift with five main implementation pillars: national urban policies, urban legislation and regulations, urban planning and design, local economy and municipal finance, and local implementation (United Nations, 2017). These pillars provide standards and principles for urban planning and development.

Special attention in implementing the NUA is given to the challenges faced by developing nations, least developed nations, landlocked nations, small island developing states, and middle-income nations (United Nations, 2017). Nations experiencing conflict or affected by disasters also require focused efforts (United Nations, 2017).

Assessing the Progress of SDG 11 in Africa

As mentioned in Section 2, Africa faces numerous obstacles to achieving SDG 11, including severe economic challenges and the persistent impact of colonial-era urban planning systems, which lead to fragmented

urban landscapes and urban sprawl (Mangweta, Mokoel, & Monama, 2022; Nnenna, Mulegi, Mbabazi, & Esther, 2023). Rapid urbanisation and rising urban unemployment further exacerbate these issues (Mangweta, Mokoel, & Monama, 2022). Africa's young and fast-growing population increases the need for sustainable urban infrastructure, yet high youth unemployment hinders progress (International Labour Organization, 2023).

Urban expansion often forces people to live on unplanned and unlawful land, straining local government's ability to provide services (Clark II, 2017). Low tax revenues limit local governments' capacity to fund infrastructure projects, necessitating innovative financing strategies like land-based financing (Sait, 2020; Cirolia, 2021). However, this can increase government expenditure and debt, highlighting the need for flexible financial instruments (Sakketa, 2023).

Furthermore, high poverty rates and inequality pose significant barriers to adopting sustainable practices (Nnenna, Mulegi, Mbabazi, & Esther, 2023). Despite efforts to address these issues, little progress has been made due to rapid urbanisation and inadequate planning (Mangweta, Mokoel, & Monama, 2022). The urban poor often live in hazardous conditions, exacerbating urban challenges (Saghir & Santoro, 2018; Cali & Menon, 2013).

Urban planners must address social exclusion, water shortages, environmental degradation, and climate change (Coulibaly & Li, 2020). Climate change increases risks like heatwaves, floods, and droughts, particularly affecting urban areas (UN-HABITAT, 2022). Urban heat islands and insufficient research on climate risks leave urban residents vulnerable (Cobbinah, 2023). Many urban policies are outdated and fail to address modern issues like urban sprawl (Vaidya & Chatterji, 2020). Rapid land use changes strain natural resources and increase greenhouse gas emissions (Mangweta, Mokoel, & Monama, 2022). Addressing these challenges is crucial for achieving sustainable urban development and improving human well-being.

Achieving the 2030 goals in Africa appears increasingly unlikely without substantial policy changes and investments (UN-Habitat, 2023). As illustrated in Figure 1, Africa is trailing behind regions like Australia, New Zealand, Northern America, and Europe in all SDG 11 indicators. While some countries have made progress in disaster risk reduction (SDG 11.5

'*Reduce the Adverse Effects of Natural Disasters*'), this progress remains uneven, highlighting the need for more effective urban planning to meet the 2030 deadline (AU/UNECA/AFDB/UNDP, 2023). Significant investments are also essential, particularly in the least developed countries, to enhance infrastructure, public transit, and resilience to natural disasters (United Nations, 2024).

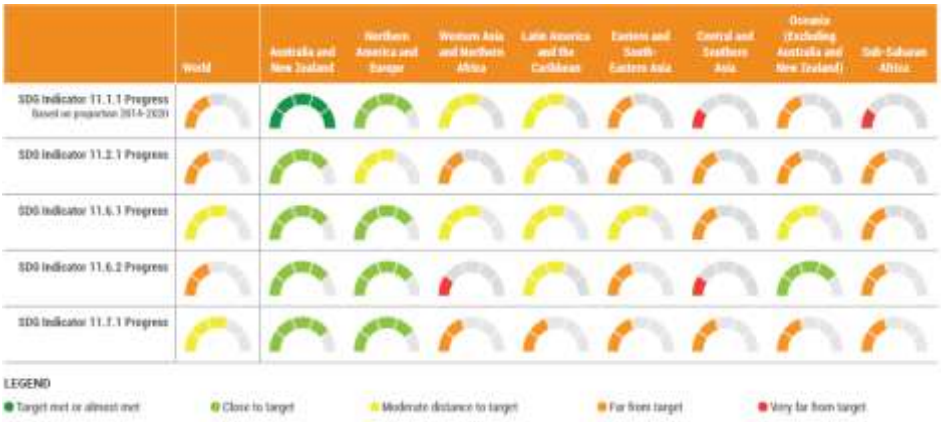

Figure 1: SDG 11 Indicators Progress Chart
Source: **(UN-Habitat, 2023)**

SDG 11 provides quantitative measures for eradicating slum conditions, delivering accessible and affordable transit systems, curbing urban sprawl, and boosting civic engagement through its ten objectives and fifteen indicators by 2030 (UN-Habitat, 2023; UN-Habitat, 2018). The objectives of SDG 11 also include enhancing the protection of cultural and natural heritage, bolstering urban resilience, mitigating and adapting to climate change, improving urban air quality, establishing safe and secure public areas for all, promoting improved urban-rural connections, and assisting least developed countries with sustainable building practices (UN-Habitat, 2023).

Despite some progress in national urban planning and transportation, significant gaps remain in addressing slum growth, public space, and waste management (UN-Habitat, 2023). Urban poverty and inequality persist, worsened by climate change and conflicts (United Nations, 2024). The number of people living in slums has increased, with 1.12 billion slum inhabitants worldwide in 2022, up from 2015. Three regions accounted for more than 85% of the world's slum dwellers: sub-

Saharan Africa (265 million), Eastern and South-Eastern Asia (362 million), and Central and Southern Asia (334 million) (United Nations, 2024). This underscores the urgent need for a comprehensive strategy to address urban housing issues in Africa and Asia, ensuring a range of housing alternatives and equitable access to essential services. Furthermore, access to public transit and open public spaces remains low, with only 28% of African people having access to public transit and 30.81% of urban areas having adequate public space (AU/UNECA/AFDB/UNDP, 2023).

Advancing SDG 11: Innovative Strategies and Solutions for Sustainable Urban Development by 2030

Digital Twin Technology for Sustainable Cities

Digital twin technology enhances city innovation and reduces costs by simulating scenarios to optimise resource allocation and urban planning (WEF, 2022; dos Santos, Campos, Montevechi, de Carvalho Miranda, & Costa, 2024). These computerised models replicate real-world systems, using logic, machine learning, simulation, and real-time data to support informed decision-making (IBM, 2024). It improves life quality by providing customised services in healthcare, education, and municipal operations, enhancing safety and reliability (WEF, 2022; Khallaf, Khallaf, Anumba, & Madubuike, 2022). By lowering innovation costs and providing cloud-based services, digital twin cities help city planners simulate and analyse urban strategies, improving sustainability and efficiency (WEF, 2022).

This technology aids in real-time monitoring of urban congestion, environmental conditions, and infrastructure, supporting sustainable growth and resource optimisation (WEF, 2022). It enables remote inspection, reduces human labour in hazardous environments, and improves urban planning and management (WEF, 2022).

African cities stand to benefit greatly from this technology, which can support the development of inclusive and sustainable smart city infrastructures (University of Pretoria, 2021; Peldon, Banihashemi, LeNguyen, & Derrible, 2024). However, implementing this technology in African cities presents challenges, particularly concerning digital inclusion, digital rights, and the risk of exacerbating social and geographical inequalities (Jieutsa, Gbaguidi, Nadifi, & Koseki, 2024). To ensure a fair and

rights-focused digital transformation, local governments must prioritise inclusive digital infrastructure and governance that safeguards residents' rights. This approach is crucial for creating resilient and sustainable smart cities that address environmental, economic, and social sustainability by enabling proactive interventions and optimising resources (Ersan, Irmak, & Colak, 2024; Elsayed, Arain, & Sallam, 2024).

Urban management in Africa can be significantly enhanced by integrating digital twin technology with advanced systems like cloud computing, artificial intelligence (AI), and the Internet of Things (IoT) (Sharifi, *et al.*, 2024; Ersan, Irmak, & Colak, 2024; Boccardo, La Riccia, & Yadav, 2024). For example, the University of Pretoria (UP) in South Africa established the Hatfield Digital Twin City (HDTC), a 10-square-kilometre area around its main campus, to advance the industrial, social, health, and environmental objectives of the city. The HDTC aims to create a comprehensive smart grid that monitors all energy consumption within the area. By understanding the different energy usage patterns—such as office buildings consuming more power during the day and residential complexes at night—the municipality can efficiently manage energy distribution by reallocating capacity where and when it is needed most. Moreover, the digital twin city can be used to monitor and control various urban systems, including food supply chains, traffic flow, water quality and quantity, air quality, public health, disease detection, crime prevention, biodiversity conservation, homelessness, urban development, and the efficiency of water and energy use in buildings, as well as business and industry optimisation. In essence, it enables comprehensive management of all aspects of a city's operations (University of Pretoria, 2021; Sharifi, *et al.*, 2024; Boccardo, La Riccia, & Yadav, 2024).

Components for Successful Sustainable Cities and Settlement

The World Economic Forum (2023) guides the development of digital twin cities using the SODPA model.[2] The model comprises five fundamental components: strategy and talent, operation and business, data and infrastructure, technology and platform, and application and scenario (WEF, 2023).

[2] The SODPA model is a process that directs the ideation of a superior virtual twin city (WEF, 2022). It is focused on people (Centre for Digital Built Britain, 2022).

We argue that these same components apply to the development of sustainable cities, leveraging scenarios from digital twin cities to inform their implementation.

- **Strategy and Talent:** Urban planning is critical to successful urbanisation. Digital twin initiatives require a strategic approach and skilled talent to drive and manage the projects (WEF, 2023). Public and private sector collaboration can develop training programs and attract qualified professionals to support digital twin city development (WEF, 2023).
- **Operation and Business:** Businesses should actively participate in developing digital twin cities and promoting public-private partnerships and sustainable economic models. Risk assessment techniques can identify potential hazards early, and governments should regulate environmental impacts through policies and levies (WEF, 2023).
- **Data and Infrastructure:** A robust data and infrastructure framework is crucial for smart cities. Governments should coordinate the layout of sensing devices, network facilities, and computational equipment, ensuring data security and privacy (Liu & Yang, 2022; WEF, 2023). Businesses must comply with regulations and collaborate to develop urban digital infrastructure (WEF, 2023).
- **Technology and Platform**: Digital twin platforms integrate and analyse municipal data, creating 3D city models and improving planning and administration through AI and machine learning (Jeong, Kim, & Kim, 2020; Mukherjee, 2022). Cities should provide Application Programming Interfaces (API) and software development kits (SDKs) for developers to create customised applications (Santana, Chaves, Gerosa, Kon, & Milojicic, 2017).
- **Application and Scenario:** Digital twin cities enhance planning, traffic control, utility management, and public safety, using real-time data for emergency response and sustainable development (Wang, *et al.*, 2023). Engaging the public through digital platforms improves participation in decision-making, service delivery and urban living conditions (WEF, 2023; Fotheringham, 2023).

Implementation Steps

An organised, phased approach is essential for implementing the SODPA model in cities. By adopting the SODPA model and following the phased approach proposed below, African cities can leverage technology to

create smarter, more resilient, and sustainable urban environments. This comprehensive and practical strategy enhances urban planning, administration, and services and provides a cost-effective solution for significant progress towards achieving SDG 11 by 2030.

- **Stakeholder involvement:** engage from the outset national and local governments, private businesses, educational institutions, and community organisations to gather input and support (WEF, 2023).
- **Pilot initiatives:** test digital twin technology in specific areas like planning and traffic management to collect data and refine methods (WEF, 2023).
- **Expansion:** scale up projects based on pilot experiences, ensuring a sustainable and scalable approach (WEF, 2023).
- **Improvement mechanism:** establish a feedback loop to monitor, assess, and enhance digital twin systems, ensuring they adapt to evolving needs (WEF, 2023).

Conclusion

In conclusion, achieving SDG 11 in Africa requires addressing deeply entrenched challenges rooted in historical, economic, and social contexts. The persistence of colonial-era planning systems, rapid urbanisation, high youth unemployment, and insufficient infrastructure are formidable barriers that must be overcome. The significant proportion of the population living in informal settlements and environmental and governance issues exacerbate these challenges.

However, innovative solutions like digital twin technology offer a promising pathway forward. Digital twins can transform African cities into more sustainable, resilient, and inclusive spaces by enabling real-time simulation, optimised resource allocation, and enhanced urban management. The successful implementation of digital twin cities hinges on strategic planning, talent development, robust data infrastructure, and strong public-private partnerships.

The SODPA model provides a structured approach to developing and managing digital twin cities, emphasising the importance of comprehensive strategy, operational efficiency, and practical applications. Pilot initiatives and stakeholder engagement are essential for refining these strategies and ensuring their scalability and sustainability.

Substantial policy reforms and increased investments in urban infrastructure are imperative to meet the 2030 targets. Innovative financing mechanisms, such as public-private partnerships and viability gap funding, are crucial to bridging the investment gap and supporting sustainable urban development.

The commentary highlights the urgency of coordinated efforts from governments, the private sector, civil society, and international organisations to drive progress towards SDG 11. By leveraging technology and fostering collaborative efforts, Africa can build cities that are not only economically vibrant but also socially inclusive and environmentally sustainable. Achieving these goals will not only fulfil the aspirations of SDG 11 but also contribute significantly to the broader 2030 Agenda for Sustainable Development.

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