How do African cities benefit from using smart technologies? Perspectives from Local Government Practitioners

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Abstract

The Fourth Industrial Revolution has immensely challenged cities across the world to review and recalibrate their strategies and systems of interfacing with their stakeholders. However, the problem is that the benefits of smart cities interventions are not well documented for African cities. This paper is interested in succinctly documenting these. This goal was achieved through a desktop literature review, as well as through empirically gathering and analyzing views of local government practitioners on the implementation of the smart city concept. In this regard, a case study of the City of Tshwane, the Capital City of South Africa, was used. The study found that the CTMM is deriving benefits from the use of smart city technologies across the dimensions of social, economic, environmental, and governance. However, the benefits are not evenly distributed among the four dimensions. The CTMM seem to be deriving more governance and economic benefits from the use of smart cities and digital technologies, compared to the social benefits. However, these findings may need to be interpreted within the context of financial and governance challenges faced by the City of Tshwane in the past 5 years.

Keywords
Smart cities, social justice, Information and Communications Technologies (ICTs), Fourth Industrial Revolution (4rth IR), Internet of Things (IoT).

1. Introduction
Some questions are been asked about the relevance of smart city interventions to solve problems faced by the majority of poor people in developing economies. Similar questions are been asked about the application of smart city interventions in South African cities (Backhouse et al., 2020). Mosco (2019) argues that municipalities need to give smart city concept interpretations which speak to their local challenges. International experience shows that successful implementation of smart cities interventions hinges on relevance to local conditions. To get a better sense of the local conditions, it is necessary to hear the voices of local government practitioners in an African context.

2. Problem statement
Most of the cited examples about successful smart cities projects are from the global South. For instance, the City of Barcelona, Spain uses the smart city concept to achieve citizen involvement and participation (Capdevila & Zarlenga, 2015). Similarly, the New York City benefit from their use as far as service delivery is concerned. In Scotland, the local authority of Glasgow uses it to improve safety in urban spaces (Janssen & Estevez, 2013). China benefits from smart technologies for urban management activities (Joo & Tan, 2020). South Korea and Japan use it for Government-led Smart cities (Ong, 2000). Similarly, India excels with a technocratic and corporatized model for smart cities (Kandpal, 2018). Hong Kong uses it for the people-centric governance model for smart cities (Joo & Tan, 2020), whereas Singapore leads with State-led smart city programs (Alleblas & Dorrestijn, 2020), and South Korea for the

top-down driven implementation of the smart cities concept. Curitiba has benefitted by using them for the community-oriented smart city concept (Joo & Tan, 2020). What about African cities? The problem is that the benefits of using smart cities are not well documented for African cities. This paper is interested in succinctly documenting these. This goal will be achieved through a desktop literature review, as well as through empirically gathering and analyzing views of local government practitioners on the implementation of the smart city concept. In this regard, a case study of the City of Tshwane, the Capital City of South Africa, was used.

2.1. Objectives
This study aims to:
- Present the implementation of the smart cities concept in the City of Tshwane.
- Gather and analyze the views and perspectives of local government practitioners regarding the benefits of the implementation of smart cities applications in the City of Tshwane.

3. Literature Review
3.1. City of Tshwane, South Africa
South Africa currently has a socio-economic versus technological chasm. This means that municipalities still have misplaced priorities in meeting the needs of their residents (Musakwa and Mokoena, 2018; Balkaran, 2019). Whereas the National Development Plan (NDP) 2030 affirms that political democracy cannot flourish when the majority of people remain in poverty and lack prospects for a better life (Balkaran, 2019), however, Musakwa and Mokoena (2018) caution that South African cities should ensure that smart cities initiatives do not deepen inequalities rather than promoting universal access to services. Some of the pressing challenges facing South Africa's municipalities include widening the poverty gap, housing crisis, water shortages, and poverty and unemployment (Marrian, 2020; Areff, 2019; Horber, 2019). Meanwhile, municipalities are still struggling to effectively engage their external stakeholders in finding solutions to the problems they face (Janssen & Estevez, 2013).

The City of Tshwane Metropolitan Council (CTMM) has embraced the notion of a smart city through its Vision 2055 strategy. According to Mr. Musa Khumalo, the Head for Shared Services, the perspective adopted by the CTMM is a city that a smart city should be able to interact better with its customers/ citizens; a city that better interacts with citizens using different channels which citizens can access; a city which can compete on technology base and so that it attracts investments; a city which functions within technological infrastructure such as 5G, so that it can survive in the future; and a city which will ensure 100% interaction with the municipality via e-Tshwane in the future (Khumalo, 2020). Over the past years, the CTMM has been implementing a range of smart city interventions intending to provide a better and safer life for citizens, improve performance and reduce operational costs, and provide the right information to stakeholders (Khumalo & Mkhwanazi, 2019).

3.2. Some African Case Studies
This section focuses on specific case studies in African cities, including Rwanda, Angola, Kenya, Senegal, Abidjan, etc. After this, a few case studies focusing on major South African Cities are explored.

3.2.1. Public-Private Partnership for Smart City Model In Rwanda
Rwanda, which is believed to be number one in the African continent in terms of smart city initiatives, is the headquarters of the Smart Africa Initiative. This is one African country that has been spearheading the agenda for smart cities in Africa. In terms of institutional arrangements, the country has a dedicated ministerial department focussing on ICTs and Youth. This department has ensured that most government services in Rwanda are moved online. The key aim is to ensure efficiency in how cities in Rwanda operate in delivering basic services, whilst on the other hand being environmentally sensitive. The implementation model includes partnerships with the private sector, academia, and environmental civil movements. Optic fibers are running across the country of Rwanda, to increase connectivity. So far, no less than 30 districts are connected to the fiber optic. So far, several impressive initiatives are being implemented in Rwanda. For instance, public buses are fitted with free internet in the capital Kigali. Manual conductors have been replaced with smart cards, and passengers simply swipe to pay fares for bus trips (Kagire, 2016).

3.2.2. Advancing Service Delivery and Economic Development Through Icts In The Angolan Capital, Luanda

The City of Luanda, in Angola, is implementing the smart city concept intending to create sustainable livelihoods, reduce inequalities, and educate the people. One of the flagship projects in Luanda is the "smart wall "project. The smart wall initiative supports the green city agenda, through the use of solar energy initiatives. In addition, there are roof gardens and vegetable plots to support sustainable livelihoods objectives, whilst making optimum use of solar energy. Through the smart wall project, citizens are provided with access to energy, water, sewer, communication, and other services. For residents, this is not just about access to services, but it also opens up opportunities to raise income and build their plots in ways that suit their conditions. For local authorities, the project assists them to get data and information about consumption patterns. In addition, the project has opened up opportunities for small-scale farmers through the roof gardens initiative. For industries, the project can allow them to count the number of kilometers of transportation, this measuring decarbonization. For local people, employment opportunities arise in trades such as carpentry, electrical trades, plumbing, etc. (Rosario, 2016).

3.2.3. Smart City Applications in Africa's Most Intelligent City – Kenya's Nairobi

Kenya is touted as Africa's Silicon Valley. The Intelligent Community Forum, which deals with problems facing development agencies globally, has recently named the City of Nairobi as Africa's most intelligent city (Nkabinde, 2016). One example of the use of ICT in Africa is the mobile money concept, which was first popularised in Kenya in the form of M-Pesa. This has allowed many poor African people to transact without standing in long queues to pay their bills and thus improved their Quality of Life (Mbassi, 2017). In Nairobi, government services payments are done electronically. The transport system is also digitized, including the collection of waste. Residents use electronic systems to make payments for daily and monthly parking fees in the Central Business District (CBD). Nairobi introduced the technologically driven Intelligent Transport System, which is expected to reduce traffic congestions by between 30% to 40%. As far as education is concerned, Nairobi introduced e-learning tools for first-time learners in its Early Childhood Education Centres. Still in Nairobi, a digital mapping system has been introduced to manage sports complexes and other recreational facilities. There are also plans afoot to introduce digital systems to operate audit functions in the City of Nairobi. As far as health care services are concerned, Nairobi has introduced Mircoclinic Tech, which has since earned international recognition. Also in health, software called Zidi is being used to improve health care facilities to improve capacity to deliver services more efficiently. As far as electricity is concerned, digital systems to improve the efficiency of electricity transmissions have been introduced as well. In slums, for instance, Mathare, ATMs have been installed for local communities. Water connection applications are also done electronically. Water vending machines have also been installed as well (Abwao, 2016).

3.2.4. Improving The Quality of Life for Rural Poor Communities in Senegal Through ICTs

The efficient flow of money remains one of Africa's major challenges, given the challenges of unemployment, poverty, and inequalities. Remittance is the money sent back home by migrants to serve as a lifeline to households who require help. The amount of remittance in Sub-Saharan Africa is set to be at the margin of $48 billion in 2019. So, the of ICTs in Africa to support the concept of mobile money, as was first popularised in Kenya in the form of M-Pesa, has allowed many poor African people to transact without standing in long queues to pay their bills, and thus improved their Quality of Life (Mbassi, 2016). Owing to the poor rate of the banking system in Senegal, the flow of cash has become dominant among rural residents. For instance, in the capital city of Senegal, almost every 10 meters there is an Orange one-stop-shop Money booth ("Touba Transfer", "Wari", or "Joni Joni"), where many young graduates have seen an opportunity to become service providers and tellers in the money transfer stores as a result of the high unemployment rate in Senegal. Currently, Senegal counts no less than 60,000 money transfer service booths or points, and young people make anything between 50 000 to 100 000 CFA francs, which is good for the Senegalese economy. These money transfers systems have proven to be extremely useful to local people. One young Senegalese local mechanic, Libass Thiam, had this to say: " ...when I fix cars for people I know, I first establish the cause of the breakdown then ask them to send me money through these services so I can buy the appropriate parts. It is a very fast process (Sane, 2016:49).

3.2.5. Smart City Applications Improve Quality Of Life And Service Delivery In Ibadan City, Nigeria

ICTs have positively changed the fortunes of Ibadan city's 4.7-million population, particularly QoL. In time past, pensioners had to trudge to banks and get stuck in long queues. Now, with the advent of the implementation of smart technologies, this is no more the case in Ibadan city of Nigeria. Right from the comfort of their homes, people are now doing financial transactions via a mobile phone to pay for school fees and other necessities. Others use ICTs to monitor

the academic performance of their children at school even before the kids could return home. Some schools within the city are running parental check apps which communicate messages to parents when a child enters or leaves the school premises. In 2011, Huawei Technologies installed a 7, 000 kilometers fiber optic cable to assist the city to implement the ambitious e-government project. This has assisted the city to discover more than 5 000 ghost civil servants, who have been earning salaries and benefits wrongfully for decades. In addition, at least 500 000 families are supplied with internet access, and dozens of workshops and seminars on "Smart City" take place, with the help of municipal authorities, international bodies, and Non-Governmental Organisations (NGOs). As far as banking is concerned, there are more than 6.7 mobile subscribers connected to smart banking. On average, every street in Ibadan has about 10 withdrawal or deposit points. E-commerce has also started, with electronic shopping taking over the city of Ibadan. As far as transport is concerned, local people can use apps to check traffic flows and congestions. During the 2014 census and 2015 presidential elections, smart technologies were also used to effectively communicate with voters in the city (Kobo, 2016).

4. Methodology
The study used secondary data in the form of books, research papers, journals, and articles. All these were presented in the form of a literature review to serve as precedents for the empirical primary interviews from City of Tshwane local government practitioners, i.e. officials. The perspectives of these practitioners were integrated and analyzed intending to get a sense of what the benefits of smart technologies are for an African city.

5. Results and Discussion
5.1. Economic benefits of smart cities interventions in Tshwane
Regarding the benefits and opportunities for the use of the smart cities technologies in the CTMM, most respondents were able to identify and categorize some of the benefits the CTMM is deriving in terms of using smart cities technologies in Tshwane. From economic benefits perceive, these include the ability of technology to allow CTMM to use less amount of money to reach many people for public participatory meetings (Babane, personal communication, 26 October 2021). Khumalo (personal communication, 09 November 2021) cites an example that through the E Tshwane App, the CTMM has been able to collect over R1 billion in revenue, from a baseline of R20-R30 million when the traditional methods were used. In addition, between 40 to 50 thousand meters is red a month, saving huge costs. A lot of money is being saved by CTMM on postal fees, fuel, paper, etc. with the new method of electronic payments and handling consumer accounts. Mandiwana (personal communication, 10 November 2021) agrees that the E Tshwane App has revolutionized how CTMM engages with customers and significantly improved access to billing and payment for services.

Matthews (personal communication, 26 October 2021) and Manaswe (personal communication, 26 October 2021) believe that the City of Tshwane is gaining more revenue with the use of smart technology compared to the time past when these were not used. Thupudile (personal communication, 04 November 2021) corroborates this view. However, for certain services, such as fire services, there are no real economic benefits as the function does not generate revenue (Le Roux, personal communication, 28 October 2021). In the case of pre-paid water meters being only implemented in Olievenhoutbosch (Region 4), Mabase (personal communication, 04 November 2021) feels that the CTMM is operating at a loss.

5.2. Social benefits of smart cities interventions in Tshwane
As far as social benefits are concerned, Babane (personal communication, 26 October 2021) posits that the use of smart technologies, especially Free-Wi-Fi, has assisted the youth in the City of Tshwane to socialize better. Matthews (personal communication, 26 October 2021) argues that the city has missed opportunities to communicate effectively with customers. Mokebe (personal communication, 26 October 2021) argues that the provision of free Wi-Fi has allowed young people to socialize in parks, libraries, and other open spaces. Nkoko (personal communication, 03 November 2021) posits that through the use of the e-health system, clinic managers have seen a reduction in long queues in clinics. However, Nxasane (personal communication, 04 November 2021) posits that the CTMM should take advantage of pilot projects which are presented as part of the Innovation program because they will make customers happier, given their track record. Thupudile (personal communication, 04 November 2021) opines that communities of Hammanskraal have been complaining about water quality, and the CTMM should have taken advantage of this situation by deploying advanced water purifications technology.

5.3. Environmental benefits of smart cities interventions in Tshwane

With regards to environmental benefits, the fact that less paper is used means that there are fewer trees that are cut (Mabase, personal communication, 04 November 2021). This contributes to a positive impact on climate change; and gas emissions. The fact that less paper is used means that there are fewer trees that are cut, and this contributes to a positive impact on climate change; and gas emissions (Khumalo, personal communication, 09 November 2021). In addition, the advent of paperless Council sessions has resulted in the city of Tshwane realizing massive saving printing costs; and reports to Council are now electronically delivered to councilors much quicker (Babane, personal communication, 26 October 2021). Matthews (personal communication, 26 October 2021) argues that the city has missed opportunities to use smart technologies to detect water leaks and thus save water and revenue. He refers to a smart system used by Joburg Water to monitor levels of water in reservoirs as one of the best available in the country currently.

5.4. Governance benefits of smart cities interventions in Tshwane

Concerning governance benefits, Van Zyl (personal communication, 27 October 2021) suggests that the use of smart cities technologies has given the CTMM ability to respond faster and efficiently to service delivery challenges. Similarly, Mmutlana (personal communication, 25 October 2021) points out that with the introduction of the 'Circular 9 electronic system' for generating reports for Mayoral Committee and Council meetings, some efficiency gains have been seen. Khumalo (personal communication, 09 November 2021) shares insights about the Electronic Record Management System, which has brought benefits of information management and retrieving of reports and documents quickly and efficiently to enable faster decision making. In addition, the CTMM management can be able to see real-time spending of money as it happens, together with milestones achieved.

In addition, the CTMM management can be able to see real-time spending of money as it happens, together with milestones achieved. As far are recruitment is s concerned, the Tshwane e-procurement system allows shortlisting of candidates immediately after the closing date, whereas with the traditional system, it can take up to three months to get there (Zaayman, personal communication, 30 October 2021). In addition, Mandiwana (personal communication, 10 November 2021) the CTMM is benefitting from digital technologies as far as performance management is concerned, as well as the application of clearance certificates.

Le Roux (personal communication, 28 October 2021) also agrees that smart cities technologies give cities benefits of efficiency. Babane (personal communication, 26 October 2021) indicates that with the advent of smart cities technologies, some of the petitions from dissatisfied communities about matters of service delivery in Tshwane are also now received and handled electronically respondents, much quicker and faster. However, it is important to note that most communities from informal settlements and townships largely still opt for manual ways of submitting petitions and service delivery complaints. Khumalo (personal communication, 09 November 2021) argues that the use of smart digital technologies has assisted the CTMM to proactively avoid audit queries from the Auditor General. Manaswe (personal communication, 26 October 2021) adds that the City of Tshwane is now able to handle compliance-related queries (e.g. illegal buildings) more efficiently with the aid of smart digital technologies.

5.5. Who benefits most of the smart cities interventions in Tshwane?

In terms of who is benefitting most from the use of smart cities technologies and applications in Tshwane, Van Zyl (personal communication, 27 October 2021) and Mabase (personal communication, 04 November 2021) argue that by and large, those that are technologically savvy benefit most. Moloto (personal communication, 09 November 2021) emphasizes that rural communities are also not covered as well; whereas those who access Android gadgets and internet services benefit most. Other respondents believe that youth, and generally people who have access to smartphones and data – especially the youth from townships, who use the Tshwane Free Wi-Fi to access data (Babane, personal communication, 26 October 2021). Matthews (personal communication, 26 October 2021) and Mmutlana (personal communication, 25 October 2021), and Mabase (personal communication, 04 November 2021) posit that the middle class, and rich people benefit more. Shuping (personal communication, 05 November 2021) says the people in the higher Living Standards Measures (LSM) group benefit more. Mokebe (personal communication, 26 October 2021) also agrees that technology also separates people according to class.

On whether business people are benefiting more than poorer communities, some respondents are of a view that general households have benefitted more than business clients (Babane, personal communication, 26 October 2021). Le Roux (personal communication, 28 October 2021) concurs that the general public has benefited more. Others believe that

business people have used their resources to take advantage of the opportunities more than general households (Van Zyl, personal communication, 27 October 2021). This view is also confirmed by Mokebe (personal communication, 26 October 2021); Manaswe (personal communication, 26 October 2021) (Zaayman, personal communication, 30 October 2021), and Makhubela (personal communication, 09 November 2021).

Thupudile (personal communication, 04 November 2021) indicates that 70% of revenue in CTMM is generated by the business sector. Although Nkoko (personal communication, 03 November 2021) shares this view, he, however, clarifies that formal businesses have benefitted more than informal businesses.

5.6. Rating the benefits in order of priority/sequence

Respondents were asked to rate (table 1), in order of significance, the most benefits the city is deriving from the use of smart technologies in the City of Tshwane in the categories of social, economic, governance, and environmental.

Table 1: Respondents Rating the Benefits of smart cities technologies in the City of Tshwane

| Nr# | Respondents | Ratings: Where 1 = highest, and 4 = lowest | | | |
		1	2	3	4
1	Babane, T,	Governance	Social	Environmental	Economic
2	Albertus, B,	Governance	Social	Economic	Environmental
3	Le Reux, D	Social	Governance	Economic	Environmental
4	Matthews, M,	Economic	Social	Governance	Environmental
5	Mmutlana, P,	Economic	Governance	Environmental	Social
6	Mokebe, T,	Governance	Social	Economic	Environmental
7	Manaswe, B,	Economic	Governance	Social	Environmental
8	Zaayman, R,	Social	Governance	Economic	Environmental
9	Nkoko, K	Social	Governance	Economic	Environmental
10	Kgadise, F	Environmental	Economic	Social	Governance
11	Mabase, S	Governance	Economic	Social	Environmental
12	Nxasane, S,	Governance	Social	Economic	Environmental
13	Thupudile, L	Social	Environmental	Governance	Economic
14	Mnguni, G,	Governance	Economic	Social	Environmental
15	Shuping, T,	Economic	Environmental	Social	Governance
16	Khumalo, M,	Economic	Social	Environmental	Governance
17	Makhubela, L.	Governance	Economic	Environmental	Social
18	Moloto, P,	Economic	Social	Environmental	Governance
19	Engelbrecht, I,	Social	Economic	Environmental	Governance
20	Madiwane, D.	Governance	Social	Environmental	Economic
TOTAL					

Source: Mathane, 2021

The results show that in the estimate of respondents, the City of Tshwane is deriving more governance and economic benefits from the use of smart cities and digital technologies, compared to the social benefits. These results may be symptomatic of the current financial and governance challenges faced by the City of Tshwane because the city has

been unstable in the past 5 financial years, and has had at least 5 Executive Mayors and no less than 3 Acting City Managers.

Shuping (personal communication, 05 November 2021) points during this time of multiple changes in management and leadership, Innovation and Research in CTMM have not been seen as a priority. Another critical finding relates to social benefits. It shows that social benefits feature strongly, making up 25% in category 1 (5 out of 20) and 40% (8 out of the 20) in both categories 2 and 3. The findings on this pillar of sustainability are significant for this study from the conceptual perspective of social justice and the right to the city. They imply that respondents view social justice as one of the key pillars and features for sustainable smart cities. Finally, it is observed that the city of Tshwane is perceived to be deriving lesser environmental benefits in the use of smart technologies compared to other categories.

5.7. Bridging the digital divide in Tshwane?

Bridging the digital divide is one of the foremost challenges facing cities to ensure inclusive smart cities. In this regard, all respondents agree that in Tshwane, the digital gap between the rich and the poor is still huge. However, some indicate that the intervention of the Free-Wi-Fi program brought by the administration of the former Executive Mayor Dr. Kgosientso Ramokgopa has done impeccable work to reduce the gap, albeit still huge at this stage (Makhubela, personal communication, 09 November 2021; Matthews, personal communication, 26 October 2021; Mandiwana, personal communication, 10 November 2021). Mmutlana (personal communication, 25 October 2021) strongly agrees with this view. In addition, Khumalo (personal communication, 09 November 2021) believes that the implementation of the broadband project in the CTMM will even assist further to reduce the digital divide.

However, Mokebe (personal communication, 26 October 2021) indicates that there is a need to look at the issue of network connectivity and the strength of the free-wife, especially in libraries. Van Zyl (personal communication, 27 October 2021) feels that the City of Tshwane could do more by ensuring that most of the customer contact services can be done using smart cell phones, especially for poorer communities. Thupudile (personal communication, 04 November 2021) opines that it is not the responsibility of municipalities to bridge the digital gap.

6. Conclusion, Recommendations, and the Way Forward

Most respondents were able to identify and categorize some of the benefits the CTMM is deriving in terms of using smart cities technologies in Tshwane. From the perspective of the economic benefits, these include the ability of technology to allow CTMM to use less amount of money to reach many people for public participatory meetings. As far as social benefits are concerned the use of smart technologies, especially Free-Wi-Fi, has assisted the youth in the City of Tshwane to socialize better. The provision of free Wi-Fi has allowed young people to socialize in parks, libraries, and other open spaces.

With regards to environmental benefits, the fact that less paper is used means that there are fewer trees that are cut. This contributes to a positive impact on climate change; and gas emissions. Concerning governance benefits, the use of smart cities technologies has given the CTMM ability to respond faster and efficiently to service delivery challenges. With the introduction of the 'Circular 9 electronic system' for generating reports for Mayoral Committee and Council meetings, some efficiency gains have been seen. The Electronic Record Management System has brought benefits of information management and retrieving of reports and documents quickly and efficiently to enable faster decision making.

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Biographies

Tlou Phillemon Mathane has over 20 years working experience in the public sector; of which more than 7 years are in the local government sphere. He is currently employed as Regional Head: Regional Operations Maintenace, at the City of Tshwane, South Africa. His main job centers around urban management and basic service delivery provisioning. He previously served as Regional Executive Director at the City of Tshwane. Previously, he worked at the National Treasury (South Africa), Financial and Fiscal Commission, and the Development Bank of Southern Africa in different roles, including budget analysis, research, and policy analysis. His qualifications include Bachelor of Administration, Bachelor of Administration Honours (University of Limpopo), Master of Commerce: Business Management (University of Johannesburg), and Masters in Town and Regional Planning (University of Pretoria). He is currently completing Masters in Sustainable Urban Planning and Development at the University of Johannesburg. He has deep interests in teaching and research, and will hopefully join academia in the future.

Prof Trynos Gumbo is a professional planner and currently an Associate Professor and Head of the Department of the Urban and Regional Planning within the Faculty of Engineering and the Built Environment in the University of Johannesburg (UJ). He holds a Ph.D. from Stellenbosch University, South Africa as well as masters and honours degrees from the University of Zimbabwe (UZ), Zimbabwe. He has previously worked in the Africa Institute of South Africa of the Human Sciences Research Council as a research specialist and Acting Head for the sustainable development programme. Prof Gumbo has also worked as an international instructor in the urban management masters programme within the Ethiopian Civil Service University College (ECSUC) in Addis Ababa in Ethiopia. Before, Prof Gumbo had worked as lecturer and Head of Department at the National University of Science and Technology (NUST) in Zimbabwe. He has attended and presented at several national and international conferences and has published widely in a variety of research areas that include informality, housing, urban planning, development, and management. His research interests include urban transportation planning and management, sustainable and smart cities development, housing and economic informality, green economy, and renewable energy generation from waste and innovative building technologies and materials.