Smart Municipalities

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Contributor: Anthea van der Hoogen, Ifeoluwapo Fashoro, Andre P. Calitz, Lamla Luke

Smart cities, as defined by Sustainable Development Goal 11, strive to make cities more inclusive, safe, resilient, and sustainable. Digital technologies addresses urbanisation concerns, such as rising energy use, pollution, waste disposal, and social inequities.

Keywords: urbanisation ; smart cities ; smart municipalities

1. Introduction

Goal 11 of the Sustainable Development Goals (SDG), which focuses on making cities and human settlements inclusive, safe, resilient, and sustainable, highlights cities as key drivers of sustainable development. Municipalities are, however, also playing an essential similar role at the local level, due to their closeness to citizens and ability to enhance collaboration, partnerships, and governance in support of sustainable development [1]. Due to urbanisation, municipal management in developing countries faces sustainability challenges. These include increased energy consumption, pollution, the disposal of toxic wastes, resource depletion, ineffective management of urban infrastructures, ineffective planning processes, overloaded transportation networks, endemic congestion, social inequality, and socio-economic disparity [2].

Smart cities are focused on producing quick solutions for urban problems, such as those identified above. Technology is key in enabling new development opportunities for smart cities, especially by enhancing existing urban processes, such as transport, health, education, government, and energy and waste management [3]. Smart cities use digital technology to improve existing urban processes by achieving more efficient coordination of smart services and providing added value to citizens through digitalisation [4].

The implementation of digitalisation has involved the use of the IoT and data-driven technologies, which are important drivers for the growth and development of smart cities and smart municipalities in maintaining their sustainability [5]. The IoT is a significant digitalised technology for infrastructure development in smart cities [6]. According to Čolaković and Hadžialić [7], the IoT is considered one of the most advanced technologies for creating a global network of machines and devices that enable effective communication and data transmission through suitable Internet connections. Therefore, it has been regarded as one of the important indicators in the development of smart cities and digital transformation (DT), enabling businesses and governments to reinvent their products, services, mode of operations, and business strategies [8].

Big data technology plays an important role in how smart cities run, especially in terms of their attempts to promote sustainability [9][10]. Large amounts of data are acquired, analysed, and used to manage, control, and regulate urban life [11]. A new phenomenon, called the data-driven city, is emerging as a result of the rise in the data faction of cities, which is mostly made possible by IoT technology. The most crucial mode of production for smart cities and sustainable smart cities has emerged as data-driven urbanism [12][13].

The IoT and Big data have been identified as enablers of DT [14]. DT primarily refers to the transformations necessary to drive digitalisation, following a digital policy [15]. DT affects the entire city or municipality, specifically the stakeholders and the environment. DT further affects how city and municipal operations are run and goes beyond digitalisation by altering basic urban processes. It restructures the city's value creation process and business logic [3].

In 2023, the global digital adoption rate was reported as 5.3 billion people using the Internet, which is 65.7% of the global population; of this percentage, 61.4% are using social media [16]. The South African population stood at 60.14 million in 2023, and digital adoption in terms of Internet use is 43.48 million (72.3%), of which 25.80 (49.9%) million are social media users [17].

Digital adoption in South Africa has provided municipalities with a learning opportunity to evolve into data-driven smart municipalities to increase productivity, growth, employment, and highly skilled citizens. However, there are no guidelines to standardise the concept of smart cities across municipalities in South Africa. There are also no DT guidelines for municipalities to guide them on how to become data-driven smart municipalities. The ad hoc implementation of DT solutions shows that limited digital transformation framework and guidelines directs municipalities on how they can transform into smart municipalities and, therefore, become data-driven.

A Value Alignment Smart City Stakeholder (VASCS) model that contributes to the success of a Smart City was developed and empirically validated by van der Hoogen et al. [18]. This research adapts and implements the VASCS model to provide a better understanding of the adoption guidelines of digitalisation and the use of DT for smart municipalities in developing countries. Therefore, this research will present the DT framework and guidelines that municipalities may use to guide their transformation into smart municipalities in the Eastern Cape, South Africa [19].

Cities are major energy consumers and account for 75% of the world's fossil fuel usage [20]. Increasing energy demands, the impact of COVID-19 on global working trends, and the war in Ukraine have all contributed to a global energy crisis that requires urgent attention and solutions [21][22]. In South Africa, the energy crisis, due to poor infrastructure and a reliance on conventional sources, such as coal, began in 2015 and has intensified over the past few years, and has hampered productivity and economic growth [23]. A coordinated energy strategy and a shift towards renewable energy are possible solutions that can be driven by the Smart City digital adoption process.

2. Urbanisation

By 2050, the world's urban population is expected to grow by 63% [24]. As of 2018, 55% of the world's population lived in cities and this number is expected to increase to 68% by 2050 [25]. Urbanisation, the increasing concentration of populations in urban areas, brings a myriad of challenges for cities and municipalities worldwide. These challenges span various dimensions, including infrastructure, public health, economy, public safety, and social equity.

A key challenge with growing urbanisation is the need for substantial infrastructure improvements. Infrastructure is critical for the economic and social wellbeing of urban residents. Climate change exacerbates these challenges, as cities must also focus on building climate-resilient infrastructure capable of withstanding extreme weather events, like floods, storms, and heatwaves [26]. Municipalities will be required to increase spending on infrastructure due to climate change as 88% of forecasted costs of adapting to climate change will be on infrastructure [26].

Urbanisation also highlights issues of social equity and public safety. The systemic discrimination and exclusion of the poor in urban agendas, coupled with an increase in violent crime rates in some areas, present significant governance challenges. Municipalities recognise the interconnections between public safety, mental health, health services, and economic development. The management of agencies responsible for public safety is influenced by municipal size and other local factors, further complicating the governance of these issues [26][27]. The path forward involves acknowledging and addressing these multifaceted challenges to ensure sustainable urban futures. Smart cities have emerged as a response to the growing challenges and opportunities created by this urbanisation [28].

3. Smart Cities and Dimensions

Albino et al. [29] (p. 6) conducted a study on Smart City definitions; although no consensus about a Smart City concept exists, the definition adopted is as follows: 'A Smart City is based on intelligent exchanges of information that flow between its many different subsystems. This flow of information is analysed and translated into citizen and commercial services. The city will act on this information flow to make its wider ecosystem more resource-efficient and sustainable. The information exchange is based on a smart governance operating framework designed to make cities sustainable'. In this definition, information flow is a key driver for smart cities and their governance in achieving sustainability.

The VASCS model [18] identified nine dimensions of a Smart City: smart economy, smart environment, smart governance, smart living, smart mobility, smart organisation, smart people, smart policies, and smart technology. Smart technology was identified as one of the supporting dimensions for the rest. In adopting the VASCS model, this research focuses on four of the nine Smart City dimensions, applicable to smart municipalities. The four dimensions discussed are smart governance, smart environment, smart living, and smart technology. These four are selected based on their impact on energy as an important and scarce resource due to urbanisation.

It is expected that by 2050, 70% of the world's population will live in cities, which will increase energy demands [30]. Therefore, cities must use smarter ways to generate, manage, and distribute energy.

Municipalities in these cities are seen as the most significant energy consumers, showing they use 75% of the world's energy and generate 70% of global CO_2 emissions [31] and growing figures are expected if nothing changes. Energy is one of the most common areas of technological innovation in smart cities because managing its consumption is a major challenge for cities [32][33]. These innovations are applied to optimise energy consumption, reduce costs and promote environmental sustainability [32]. Smart technologies, such as smart grids, smart metering and IoT technologies for real-time monitoring and data collection have been implemented to meet challenges in Smart City dimensions, such as smart living (electric vehicles, smart homes and buildings) and smart environment (renewable energy sources) [32]. The success of these technologies will largely depend on the implementation of appropriate governance (smart governance) strategies.

3.1. Smart Governance

Several cities have launched transformational programs, known as Smart City initiatives, to serve inhabitants better and improve their quality of life [34][35]. Multiple stakeholders are involved in these initiatives. As a result, a greater demand for stronger governance to oversee these projects and initiatives has emerged in various studies [36]. In order to achieve goals and objectives, governance entails implementing processes involving stakeholders who share information according to norms and standards [37].

The introduction of IT that improves governance has benefited several cities. Smart governance refers to IT-based government. It encompasses various technologies, people, laws (such as energy consumption), practices, resources, social norms, and data that work together to enable municipal governance. Smart governance lies at the heart of Smart City projects [38].

3.2. Smart Environment

On the environmental front, Smart City efforts should be forward-thinking [39]. The use of technologies to promote sustainability and better manage natural resources is central to the concept of a Smart City [31][40]. Natural resources and related infrastructure, such as canals and sewers, as well as green areas, such as parks, are relevant [41]. These elements, taken together, impact a city's sustainability and liveability; hence, they should be considered while evaluating Smart City programmes.

Law and Lynch [31] emphasise that the sustainability of a smart environment must be approached through the prevention of high energy consumption, and through renewable energy, smart grids, pollution control, green buildings, green urban management, efficiency, utilisation, urban grid, street lighting, waste management, drainage systems, monitoring water resources, reducing contamination, and improving water quality.

3.3. Smart Living

Globally, the development of smart cities aims to provide residents with a higher quality of life using new and improved IT. The Smart City, which has connected and effective parts, is the most complex urban plan based on IT. Smart living is not easy for all residents to understand, because it is based on immersive information and data and is driven by intelligent networking by people and services [37]. Providing citizens with information based on modern technologies and raw data is important. More importantly, by developing their thinking, citizens must be aware of the services and accessibility that may be available to them in their specific geographic contexts based on their interests and preferences [42].

3.4. Smart Technology

The availability and quality of IT infrastructure are critical for smart cities [43][44]. Wireless infrastructure, including fibre optic channels, Wi-Fi networks, wireless hotspots and kiosks [45][46], and service-oriented information systems are examples of these critical IT infrastructures [47][48]. E-government technology barriers shall be referred to as Smart City IT infrastructure barriers, as these projects are similar to e-government initiatives in their use of IT [49].

When using IT, it is important to emphasise the need to remove inequities, close the digital divide, and improve individual capability and resource availability [37]. Regardless of their willingness to participate in smart urbanisation, vulnerable members of society grow more and more estranged because of inequality [50]. When implementing IT, municipal administrators should consider willingness, institutional resources, availability, capability, dissimilarity, changing culture, digital divide, and habits.

4. Smart Municipalities

Smart municipalities, promote sustainable development and support the achievement of environmental goals using technology [51]. Improved quality of life should also be a goal for any Smart Municipality's effort to enhance the lives of citizens. This is measured by comparing the citizens' quality of life before and after these efforts. The VASCS model [18] proposes that transitioning from the traditional to a Smart City model and using the benefits/value realisation component can aid in mapping the value for such efforts and understanding where the gaps exist.

According to Vial [52] and Verhoef et al. [3], municipalities are required to increase their service delivery operations through digital transformation by using various digital technologies [52]. However, using digital technology alone would not guarantee digital municipal transformation, especially if their adoption is poorly planned and improperly implemented or lacks the support of high management [53].

4.1. Smart Municipalities at the International Level

The Case of Vienna

In 2011, the Vienna Smart City drive was launched and the city started the essential process by uniting partners from different municipal offices and other relevant stakeholders in 2013 [54]. This led to the 'Smart City Wien Framework

Strategy' in 2014, which aimed to provide guidelines for developing the Smart City initiative. This strategy had three main areas: quality of living, resources, and innovation, which coordinated specific issues and points. Despite the common points and differences in models for implementing a Smart City, stakeholders in the Vienna Smart City project agreed that governance was the most important dimension, followed by people and the environmental dimension. However, in terms of implementation, there were more projects for the environmental dimension. This highlighted a disconnect between actual project implementation and stakeholder perspective.

The Case of Aarhus

Denmark provides a favourable environment for developing and testing the Smart City concept due to the country's long history of incorporating different stakeholders in its decision-making process, especially in urban planning and environmentalism [55]. As a result of this legacy, the country was the first to pass an environmental protection law in 1973. Aarhus is Denmark's second-largest city, with a population of more than 320,000 individuals. The initiative was built around Smart Aarhus and traces back to a gathering in 2010 where interested managers and directors met with agents from Aarhus University and the Alexandra Institute. This exclusive, charitable association helps public and private associations create innovative IT-based products and services to encourage development and prosperity in Danish society. Confronted with similar difficulties as numerous urban communities worldwide, which are increasing populations, limited revenue, and high expectations for what the city should offer, an alternative approach was envisaged to make the city liveable for all inhabitants.

Smart Aarhus has completed three milestones during the last few years. These are known as the 'pillars' of Smart Aarhus' success, and each continues to grow. The first pillar is Open Data Aarhus. The city of Aarhus was the first in Denmark to create such a service, and Open Data Aarhus now presents more than 75 datasets [55]. Internet Week Denmark is the next pillar. This event started in April 2014 and aimed at making IT solutions more relevant and visible to the community. The third pillar, Aarhus Challenges, involves figuring out the city's social problems. This critical thinking strategy, for instance, uses digital means to make it easier for the elderly to use the Internet.

4.2. Smart Municipalities at the National Level (South Africa)

Cities continue to be the engine of the economy and the homes of most South Africans. Still, they continue to face challenges, such as insufficient infrastructure, service delivery funding, and consumer affordability of municipal services [56]. Municipalities, also known as local governments in South Africa, are recognised as a distinct and independent level of government, with assigned powers and responsibilities unique to this level. There are 278 municipalities in South Africa, with 8 metropolitan municipalities, 44 district municipalities, and 226 local municipalities [57]. They are mostly interested in strengthening local economies and providing infrastructure and services.

Following the definition of smart municipalities, it can be confirmed that most South African municipalities are not yet smart municipalities. This is because they use IT on an ad hoc basis and the status quo in South African municipalities is the opposite of what is defined as smart municipalities [58].

The Smart City concept was primarily implied in government objectives and plans, with private real estate developers yet to embrace the concept fully. However, during his State of the Nation Address in 2022, President Cyril Ramaphosa declared that his Smart City goal had become a 'reality in the making' with the launch of the Lanseria Smart City [59]. The city focuses on adopting 'best practices' in urban sustainability and the ideas underpinning a Smart City to build the first post-apartheid metropolis in South Africa's democratic, developing economy [60]. Other examples of smart cities in South Africa are discussed below.

The Case of Johannesburg

The most unprecedented increase in the use of the term Smart City in the South African mediascape is from Johannesburg [61]. From 2014 to 2018, the term and discussions around the topic had precedent. For instance, the Joburg Broadband Network Project has existed since 2007, when the regional government established a framework for public–private collaboration [62][63][64]. The main goal was to place Johannesburg as an investment-friendly city with a state-of-the-art ICT infrastructure, increasing access to broadband and decreasing the digital gap [61]. Due to the challenges in the public sector, it was determined that working with the private sector would be important to understand this target. Under the rationales of the digital city, such joint initiatives with the private sector were accordingly not centred around the broader deregulation of the governance space but focused more on executing a state-driven project.

The Case of Cape Town

Cape Town is South Africa's second largest metropole. Businesses, industries, public society, and academia founded the Western Cape Economic Partnership, a non-profit organisation that developed a long-term vision for the province as a center of innovation and creativity in IT programming. The purpose of local government, according to the plan, is to enable access to IT and related services through integrated service nodes and IT access at public facilities and buildings, as well as at hotspots in public areas [50].

The Western Cape Department of Economic Affairs and Tourism launched another project dubbed ‘Connected Cape’ as part of their broadband rollout plan. Through infrastructure construction, guaranteeing readiness to use this infrastructure, and encouraging adoption of these services, the plan focuses on connected citizens, connected government, and a connected economy. As a result, the government’s role in accelerating and facilitating the development and growth of ICT infrastructure is dominating. The City of Cape Town additionally helps bulk infrastructure rollout by providing internet access between provincial and local government facilities, as well as schools in underserved areas [50].

The Case of eThekwini

eThekwini (Durban) is South Africa’s third-largest metropolitan region. It was one of the main urban regions that implemented the Smart City concept. The Smart City articulation frames the relationship between equitable infrastructure and market pressures, in which local policy agendas are intertwined with the developmental power of IT [50]. Although this concept exists in various urban communities (for example, Cape Town, Johannesburg, and Ekurhuleni), eThekwini dubbed these rationales ‘Smart’ much earlier, emphasising the need to market its broadband fibre optic link network with a private sector partner and to begin the rollout of less expensive broadband and telecommunication services to businesses and residents as early as 2007 [65]. The eThekwini strategy demonstrates that the Smart City concept may be implemented locally without centralisation.

References

1. Fenton, P.; Gustafsson, S. Moving from high-level words to local action—Governance for urban sustainability in municipalities. Curr. Opin. Environ. Sustain. 2017, 26–27, 129–133.
2. Schmitt, G. Smart Cities. 2020. Available online: https://courses.edx.org/courses/course-v1:ETHx+ETHx-FC-03x+2T2017/courseware/9c5797d2aaa341d08e921b986a585ffc/90631b2993cb419181b0e02962d35584/?activate_block_id=block-v1%3AETHx%2BETHx-FC-03x%2B2T2017%2Btype%40sequential%2Bblock%4090631b2993cb419181b0e029 (accessed on 20 November 2023).
3. Verhoef, P.C.; Broekhuizen, T.; Bart, Y.; Bhattacharya, A.; Dong, J.Q.; Fabian, N.; Haenlein, M. Digital transformation: A multidisciplinary reflection and research agenda. J. Bus. Res. 2021, 122, 889–901.
4. Anthony, B. Distributed ledger and decentralised technology adoption for smart digital transition in collaborative enterprise. Enterp. Inf. Syst. 2021, 17, 1989494.
5. Rathore, M.M.; Paul, A.; Ahmad, A.; Chilamkurti, N.; Hong, W.H.; Seo, H.C. Real-time secure communication for Smart City in high-speed Big Data environment. Future Gener. Comput. Syst. 2018, 83, 638–652.
6. Park, E.; del Pobil, A.P.; Kwon, S.J. The role of Internet of Things (IoT) in smart cities: Technology roadmap-oriented approaches. Sustainability 2018, 10, 1388.
7. Čolaković, A.; Hadžialić, M. Internet of Things (IoT): A review of enabling technologies, challenges, and open research issues. Comput. Netw. 2018, 144, 17–39.
8. Chang, H.; Mikalsen, K.S.; Nesse, P.J.; Erdal, O.B. Digitalisation of Municipalities through Ecosystem Collaboration. Nord. Balt. J. Inf. Commun. Technol. 2020, 2019, 117–158.
9. Bibri, S.E.; Krogstie, J. A novel model for data-driven smart sustainable cities of the future: A strategic roadmap to transformational change in the era of Big data. Future Cities Environ. 2021, 7, 3.
10. Nelson, A.; Neguriţă, O. Big data-driven smart cities: Internet of Things devices and environmentally sustainable urban development. Geopolit. Hist. Int. Relat. 2020, 12, 37–43.
11. Bibri, S.E.; Krogstie, J. A scholarly backcasting approach to a novel model for smart sustainable cities of the future: Strategic problem orientation. City Territ. Archit. 2019, 6, 3.
12. Kitchin, R. Data-driven urbanism. In Data and the City, 1st ed.; Routledge: New York, NY, USA, 2017; pp. 44–56. Available online: https://www.taylorfrancis.com/chapters/edit/10.4324/9781315407388-4/data-driven-urbanism-rob-kitchin (accessed on 23 June 2022).
13. Bibri, S.; Krogstie, J. The emerging data–driven Smart City and its innovative applied solutions for sustainability: The cases of London and Barcelona. Energy Inform. 2020, 3, 2–42.
14. Sestino, A.; Prete, M.I.; Piper, L.; Guido, G. Internet of Things and Big Data as enablers for business digitalization strategies. Technovation 2020, 98, 102173.
15. Bertola, P.; Teunissen, J. Fashion 4.0. Innovating fashion industry through digital transformation. Res. J. Text. Appar. 2018, 22, 352–369.
16. Petrosyan, A. Worldwide Digital Population 2023. In Statista. 2023. Available online: https://www.statista.com/statistics/617136/digital-population-worldwide/#:~:text=Worldwide%20digital%20population%202023&text=As%20of%20October%202023%2C%20there,population%2C%20v (accessed on 13 February 2023).

17. Kemp, S. Digital 2023: South Africa. Datareportal. Available online: https://datareportal.com/reports/digital-2023-south-africa#:~:text=There%20were%2043,between%202022%20and%202023 (accessed on 13 February 2023).
18. van der Hoogen, A.; Scholtz, B.; Calitz, A.P. Using Theories to Design a Value Alignment Model for Smart City Initiatives. In Responsible Design, Implementation and Use of Information and Communication Technology. I3E 2020. Lecture Notes in Computer Science; Hattingh, M., Matthee, M., Smuts, H., Pappas, I., Dwivedi, Y., Mäntymäki, M., Eds.; Springer: Cham, Switzerland, 2020; Volume 12066, pp. 55–66.
19. Pierce, P.; Andersson, B. Challenges with smart cities initiatives: A municipal decision makers' perspective. In Proceedings of the Annual Hawaii International Conference on System Sciences, Waikoloa, HI, USA, 4–7 January 2017.
20. UN-Habitat. Urban Energy. Available online: https://unhabitat.org/topic/urban-energy (accessed on 23 November 2023).
21. Besson, V. How the Energy Crisis Is Transforming the Global Economy. KPMG. 2022. Available online: https://kpmg.com/fr/fr/blogs/home/posts/2022/03/how-the-russia-ukraine-crisis-impacts-energy-industry.html (accessed on 23 November 2023).
22. Kim, H.; Choi, H.; Kang, H.; An, J.; Yeom, S.; Hong, T. A systematic review of the smart energy conservation system: From smart homes to sustainable smart cities. Renew. Sustain. Energy Rev. 2022, 140, 110755.
23. Mathekga, R. Southern Africa's Energy Crisis. GIS Reports. 2023. Available online: https://www.gisreportsonline.com/r/southern-africa-energy/ (accessed on 23 November 2023).
24. United Nations Department of Economic and Social Affairs. World Urbanization Prospects 2018—Highlights. 2018. Available online: https://www.un.org/development/desa/pd/sites/www.un.org.development.desa.pd/files/files/documents/2020/Feb/un_2018_wup_highlights. (accessed on 20 November 2023).
25. United Nations Department of Economic and Social Affairs. World Urbanization Prospects: The 2018 Revision. 2018. Available online: https://population.un.org/wup/Publications/Files/WUP2018-Report.pdf (accessed on 20 November 2023).
26. Omeyr, F.; Ai, S.
27. UN-Habitat. World Cities Report 2022: Envisaging the Future of Cities. Available online: https://unhabitat.org/world-cities-report-2022-envisaging-the-future-of-cities (accessed on 12 January 2024).
28. Estevez, E.; Lopes, N.V.; Janowski, T. Smart Sustainable Cities. Reconnaissance Study. 2016. Available online: https://egov.unu.edu/news/news/smart-sustainable-cities-reconaissance-study.html (accessed on 29 January 2024).
29. Albino, V.; Berardi, U.; Dangelico, R.M. Smart cities: Definitions, dimensions, performance, and initiatives. J. Urban Technol. 2015, 22, 3–21.
30. ur Rehman, U.; Faria, P.; Gomes, L.; Vale, Z. Future of energy management systems in smart cities: A systematic literature review. In Sustainable Cities and Society; Elsevier Ltd.: Amsterdam, The Netherlands, 2023; Volume 96.
31. Law, K.H.; Lynch, J.P. Smart City: Technologies and Challenges. IT Prof. 2019, 21, 46–51.
32. Pandiyan, P.; Saravanan, S.; Usha, K.; Kannadasan, R.; Alsharif, M.H.; Kim, M.K. Technological advancements toward smart energy management in smart cities. Energy Rep. 2023, 10, 648–677.
33. Ptak, A. Smart city management in the context of electricity consumption savings. Energies 2021, 14, 6170.
34. Alawadhi, S.; Scholl, H.J. Smart governance: A cross-case analysis of Smart City initiatives. In Proceedings of the 2016 49th Hawaii International Conference on System Sciences (HICSS), Kaloa, HI, USA, 5–8 January 2016; pp. 2953–2963.
35. Scholl, H.J.; AlAwadhi, S. Smart governance as key to multi-jurisdictional Smart City initiatives: The case of the eCityGov Alliance. Soc. Sci. Inf. 2016, 55, 255–277.
36. Viale, P.G.; Cunha, M.A.; Lampoltshammer, T.J.; Parycek, P.; Testa, M.G. Increasing collaboration and participation in Smart City governance: A cross-case analysis of Smart City initiatives. Inf. Technol. Dev. 2017, 23, 526–553.
37. Chourabi, H.; Nam, T.; Walker, S.; Gil-Garcia, J.R.; Mellouli, S.; Nahon, K.; Pardo, T.A.; Scholl, H.J. Understanding smart cities: An integrative framework. In Proceedings of the 2012 45th Hawaii International Conference on System Sciences, Maui, HI, USA, 4–7 January 2012; pp. 2289–2297.
38. Lopes, N.V. Smart governance: A key factor for smart cities implementation. In Proceedings of the 2017 IEEE International Conference on Smart Grid and Smart Cities (ICSGSC), Singapore, 23–26 July 2017; pp. 277–282.
39. Anthopoulos, L. Defining Smart City architecture for sustainability. In Proceedings of the 14th Electronic Government and 7th Electronic Participation Conference (IFIP2015), Thessaloniki, Greece, 30 August–2 September 2015; pp. 140–147.
40. Allam, Z. Contextualising the Smart City for sustainability and inclusivity. New Des. Ideas 2018, 2, 124–127.
41. Chong, M.; Habib, A.; Evangelopoulos, N.; Park, H.W. Dynamic capabilities of a Smart City: An innovative approach to discovering urban problems and solutions. Gov. Inf. Q. 2018, 35, 682–692.
42. Roche, S.; Nabian, N.; Kloeckl, K.; Ratti, C. Are 'smart cities' smart enough. In Spatially Enabling Government, Industry and Citizens; Research Development and Perspectives; GSDI Association Press: Needham, MA, USA, 2012; pp. 215–

235.

43. Lövehagen, N.; Bondesson, A. Evaluating sustainability of using ICT solutions in smart cities–methodology requirements. In Proceedings of the International Conference on Information and Communication Technologies for Sustainability, Zurich, Germany, 14–16 February 2013; p. 175. Available online: https://www.ericsson.com/4ac624/assets/local/reports-papers/research-papers/loevehagen-bondesson-evaluating-sustainability-of-using-ict-solutions.pdf (accessed on 23 January 2023).
44. Liu, D.; Huang, R.; Wosinski, M. Development of smart cities: Educational perspective. In Smart Learning in Smart Cities; Springer: Singapore, 2017; pp. 3–14.
45. Musa, S. Smart cities—A roadmap for development. J. Telecommun. Syst. Manag. 2016, 5, 1000144.
46. Talha, M.; Upadhyay, A.; Shamim, R.; Beg, M.S. A cloud integrated wireless garbage management system for smart cities. In Proceedings of the 2017 International Conference on Multimedia, Signal Processing and Communication Technologies (IMPACT), Aligarh, India, 24–26 November 2017; pp. 175–179.
47. Elhoseny, H.; Elhoseny, M.; Abdelrazek, S.; Bakry, H.; Riad, A. Utilising service-oriented architecture (SOA) in smart cities. Int. J. Adv. Comput. Technol. IJACT 2016, 8, 77–83.
48. Clement, S.J.; McKee, D.W.; Xu, J. Service-oriented reference architecture for smart cities. In Proceedings of the 2017 IEEE Symposium on Service-Oriented System Engineering (SOSE), San Francisco, CA, USA, 6–9 April 2017; pp. 81–85.
49. Razmjoo, A.; Østergaard, P.A.; Denai, M.; Nezhad, M.M.; Mirjalili, S. Effective policies to overcome barriers in the development of smart cities. Energy Res. Soc. Sci. 2021, 79, 102175.
50. Odendaal, N. Everyday urbanisms and the importance of place: Exploring the elements of the emancipatory Smart City. Urban Stud. 2021, 58, 639–654.
51. De Marco, A.; Mangano, G. A review of project management practices in EU-funded Horizon2020 projects. Procedia Comput. Sci. 2023, 219, 2075–2083.
52. Vial, G. Understanding digital transformation: A review and a research agenda. J. Strateg. Inf. Syst. 2019, 28, 118–143.
53. Andriole, S.J. Five myths about digital transformation. MIT Sloan Manag. Rev. 2018, 58, 20–22.
54. Fernandez-Aneza, V.; Fernández-Güell, J.; Giffinger, R. Smart City implementation and discourses: An integrated conceptual model. The case of Vienna. Cities 2018, 78, 4–16.
55. Snow, C.C.; Håkonsson, D.D.; Obel, B. A Smart City is a collaborative community: Lessons from smart Aarhus. Calif. Manag. Rev. 2016, 59, 92–108.
56. SACN-South African Cities Network. State of City Finances Report 2020; SACN: Johannesburg, South Africa, 2020; ISBN 978-1-920704-31-5.
57. Kleynhans, E.P.; Coetzee, C. Assessment of financial conditions of South African Municipalities: A unique model for KwaZulu-Natal. S. Afr. Bus. Rev. 2019, 23, 25.
58. Mashau, N.L.; Kroeze, J.H.; Howard, G.R. Key Factors for Assessing Small and Rural Municipalities' Readiness for Smart City Implementation. Smart Cities 2022, 5, 1742–1751.
59. Mzekandaba, S. SONA: Ramaphosa's Smart City Dream Becomes 'Reality in the Making.' ITWeb. Available online: https://www.itweb.co.za/content/raYAyModR6nqJ38N (accessed on 12 February 2021).
60. Scholtz, B.; van der Hoogen, A. Access to Technology and Data in Smart Cities for South African Digital Citizens. In Proceedings of the African Conference on Information Systems and Technology, Thyolo, Malawi, 25–26 August 2022.
61. Söderström, O.; Blake, E.; Odendaal, N. More-than-local, more-than-mobile: The Smart City effect in South Africa. Geoforum 2021, 122, 103–117.
62. Scott, I. Digital City Partnerships "Key". ITWeb Online. 2005. Available online: https://www.itweb.co.za/article/digital-city-partnerships-key/LPp6VMr1VAz7DKQz/ (accessed on 17 April 2022).
63. Scott, I. Broadband Strategies 'Critical'. ITWeb Online. 2005. Available online: https://www.itweb.co.za/article/broadband-strategies-critical/Olx4zMkyZWrv56km (accessed on 17 April 2022).
64. Senne, D.; Czernowalow, M. Joburg Advances towards 'Digital City'. 2007. Available online: https://www.itweb.co.za/content/VgZeyqJV625qdjX9 (accessed on 17 April 2023).
65. Naidoo, S. Faster, Cheaper Net Access on the Cards for eThekwini. The Mercury, 26 April 2007, p. 25. Available online: https://www.iol.co.za/technology/faster-cheaper-net-access-on-the-cards-for-ethekwini-894282 (accessed on 23 September 2022).