The role of smart cities to promote smart governance in municipalities

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Abstract

The main focus of this paper is to provide a contextualized reflection about what smart cities are and their primary contribution in promoting smart governance.

Objectives

Objectives include amongst others, the definition of the smart city concept and how it can be used as a means to achieve more efficient and sustainable cities. It further elucidates the use of internet enhanced public service delivery to promote smart governance in municipalities.

Prior Work

This paper is built upon existing prior work that has been done in the emerging trends in smart cities. Researchers have identified several different "discourses" related to smart cities However, this paper delves deeper into how innovation and the concept of internet of things can enhance public service delivery. It further contextualizes the use of internet enabled public services with the purpose of making municipalities smart cities, with smart governance by offering smart services to its communities.

Approach

A qualitative research approach was used to fulfil the objectives of the paper through an in-depth desktop analysis of existing literature from recent journals.

Results

The research findings traverse that although a plethora of challenges remain, it is the amenability of both the political and administrative leadership and the gravity attached to technology that determines the extent of depth of transforming municipalities towards the goal of being smart cities.

Implications

The overall goal of this paper is to lay a foundation for the development of a comprehensive framework to redirect administrators and political office bearers towards smart city and smart governance inclined policy directives as suggested in the research findings. Inferences drawn from the paper will assist in further research in the field of innovation, smart cities and smart governance as wheels and machinery of service delivery.

Value

Finally, this paper attempts to merge theory and practice to work towards understanding of what a smart city means for South African cities through smart governance manage and minimize challenges confronted by municipalities through the use of technology.

Keywords: Innovation, E-governance, ICT infrastructure, Internet of Things, Smart City, Smart governance

1. Introduction

The Fourth Industrial Revolution is altering governance models in a distracting way thus prompting a drastic paradigm shift towards digital transformative oriented governance. This has brought many challenges particularly in urban areas. In their endeavours to address

the urban challenges arising from migration of citizens from rural to urban areas, local governments around the world have embraced smart city agendas.

Mosco [11] argues that countries considered to be smart have adopted the smart agenda to respond to local challenges. The President of South Africa emphasized the role that Smart Cities and the Fourth Industrial Revolution (4IR) could play in managing the challenges of urbanization in South Africa in both the 2019 and 2020 State of the Nation Address (SONA).

Abbas [16] highlights that "throughout the world, cities are growing at exponential rates. In 1910, 10% of the world's population lived in cities. By 2014, 50% of the world's population lived in cities, and it is projected that, by 2050, 75% of the world's population will live in cities."

The assertion by Abbas [16] is further highlighted by Das and Misra [12], that according to the United Nations report it can be argued that 54% of the world's population was living in cities in 2014, which is expected to abruptly rise to 66% by 2050.

It can be argued that these escalating migration patterns to cities exerts an enormous pressure on the infrastructure resources of cities hence the assertion by the President of South Africa in the 2019/20 SONA to employ new strategies to ease the burden.

Kim, Subri and Kent [6] posit that the term smart city did not originate on smart urban growth in the 1980's. Rather, it is a new term in a new paradigm shift of the fourth industrial revolution and digitalization of using the World Wide Web, Internet of Things (IoT) and Artificial intelligence (AI). Kitchin [7] envisions that many urban managements have adopted a digital infrastructure to increase productivity, connectivity and improve future urban form. Furthermore, the role of ICT in fostering innovation is a digital disruption which is aiming at driving towards better virtual cities. Moreover, the development of smart city concept using the vehicle of digitization of modern cities is the way forward for urban future development, knowledge and empowerment of cities. Digital infrastructure is a core driver in the ubiquitousness of cities to improve public service delivery [6].

The role of governance in smart cities is vital given their decision-making power. In the South African context, municipalities are tasked with both legislative as well as Executive authority as enshrined in Chapter 3 of the Constitution (1996), Municipal Structures Act 117 of 1998 and the Municipal Systems Act 32 0f 1998, respectively. It is against this constitutional mandate that the researcher argues that in managing challenges of urbanization in pursuit of a better life, South African Municipalities have to adapt the concept of smart cities and effectively use technology to deliver services smarter to the communities.

According to Yiu [5], every city needs to achieve a base level of smart administration to ensure efficiency, good governance and service delivery, to support the easy of doing business and provide a positive experience for residents.

1.1   Objectives

The main objective of this paper is to provide adetailed description of smart cities and the use of internet enhanced public service delivery to promote smart governance in municipalities. This study seeks to provide answers to the following research questions:
•   What does the concept smart city entail?
•   How do municipalities use the concept of smart governance in smart cities?
•   Which technologies do smart cities adopt in ICT in a smart city initiative to improve smart governance?
•   What are the components of smart cities on a global perspective?
•   What are the possible recommendations for the smart city initiative?

1.2   Definition of Smart Cities

According to the 2021 European Commission, a smart city is a place where traditional networks and services are made more efficient with the use of the digital technology of telecommunications for the inhabitants and business. This concept was birthed in the New Urban Agenda with the UN Habitat [22]. Luque [21] posits that some misunderstandings have risen to the use of the word smart city as it is mixed up with smart growth management or new urbanism, but in theory the two concepts are diverse worlds apart.

1.3   Historical overview of Smart Cities

Goh and Arenas [2] emphasizes that the research in how public sector and governments should incorporate ICT innovations in their cities to improve socio-technical improvements for citizens has been done in many countries. The concept started to be more popular in the 2000's because of the millennium which saw many public sectors and governments vying for the ICT driven cities [17]. Moreover, the concept of smart cities is harnessed to ICT based smart city, a concept that started getting popular in European cities. Furthermore, the concept started picking momentum as municipalities were starting to recognize the concept of connectivity infrastructure as a panacea to their city problems.

1.4   Innovation in the Smart Cities

Various authors have done research in the innovation as a driver in the development of smart cities. Benbunan-Fich, Desouza and Normann Anderson [14] have the view that smart cities are a place for technological and social innovation for cities. Furthermore, the authors explain the core use of this innovation in the productivity, sustainability and liveability of people. Paskaleva and Cooper [8] argue that open innovation is much needed in modern cities and must be internet enabled to facilitate good service delivery to inhabitants of cities for nations. The trend of the new millennium is that the public sector is increasingly moving into the digital age and now takes advantages of the IT innovations [14]. The next part discusses the advantages of these ICT innovations.

1.5   Advantages of Smart Cities

According to Yiu [5], the digital transformation is affecting all the sectors of the public sectors in increasing productivity, enhancing service delivery, and improving connectivity. Furthermore, big data, AI and IoT concepts are enabling the municipality administrators in E-governance to be faster, smarter and implement effective solutions for cities [5]. Benbunan-Fich and Castellanos [4] also explains the increase in modernization by using blockchain technology as a catalyst of record modernization and regulatory compliance. In another view, Kankanhalli et al. [3] posits that the advance of IoT and related sensor technology are likely to shape infrastructure development in cities and local municipalities. However, the advanced IoT is enabling cities to be better and more habitable although it has more challenges

1.6   Public services offered by Smart Cities

According to the OECD Report [15] the public services that are likely to be offered by the smart cities are:
•   The provision and sustainable management of natural resources through big data analytics such as citizen housing records;
•   Online learning using E-Library;
•   E-payment of public service accounts such as rates and water bills;
•   E-commerce purchase of some public service in a virtual shop or services, for example buying electricity using cards or via some virtual vendors;
•   Food sharing services and apportioning of scarce resources via an app such as online food sharing services;
•   Proper communication of the inhabitants via intranets and social media groups;
•   5G wireless internet services to inhabitants;
•   Retrieving and storage of receipts and credit records electronically in government public amenities service delivery places such as municipality, water and electricity;
•   Storage of data and documents for E-Governance through cloud computing infrastructure for policy making.

1.7   Components of smart cities

The following diagram illustrates smart manufacturing, smart governance, smart digital citizens, open data, smart health, smart buildings, smart transportation and smart grid and energy utilities. This is a component of the IoT illustration.
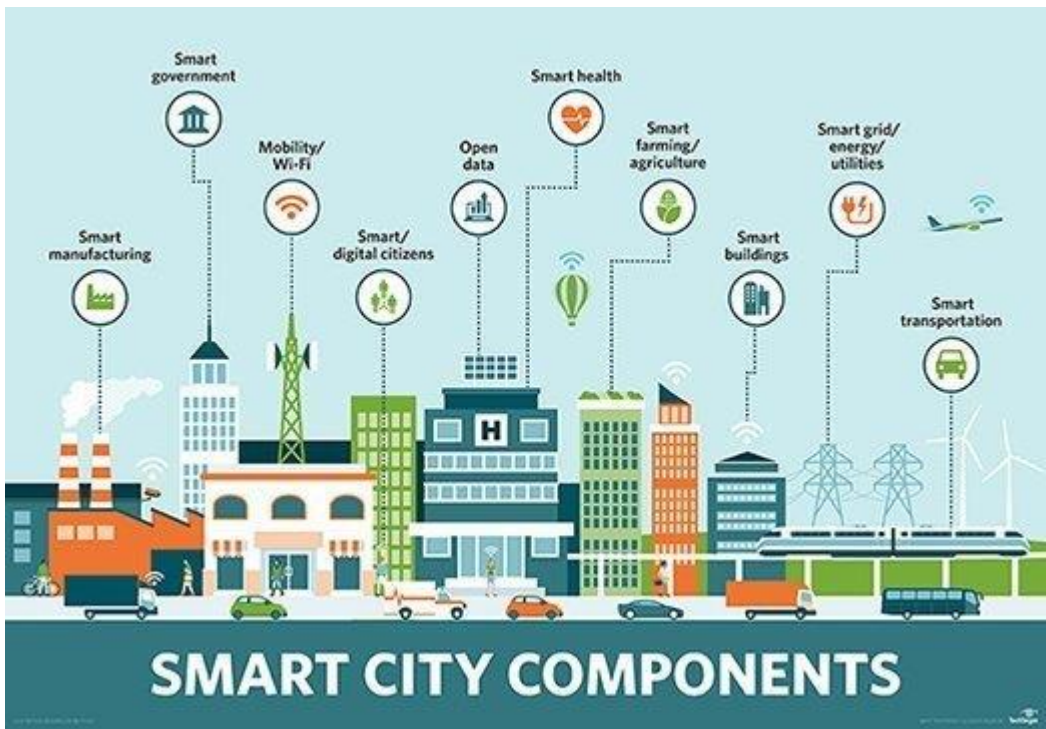
Fig 1: IOT components in smart cities of modern cities   Source: Kim, Sabri and Kent [6]

2. Research methodology/design/approach

The paper sought to analyse the role of smart cities in promoting smart governance in municipalities. Almost all municipalities in SA are plagued with serious challenges of urbanization thus exerting enormous pressure on the service delivery infrastructure which cripples the ability of most municipalities to deliver to their core mandate. One of the anticipated outcomes of this study is that of placing the concept of smart cities at the centre and the pedestal of being the driving force towards smart governance.

This section of the study centres on the exposition of the research design and methodology which are respectively the blueprint of the study and various issues surrounding the different methods that have been utilised in pursuance of the research objectives.

Babbie and Mouton [18] conceptualize research design as the plan or blueprint of how one intends conducting research.

For Kar, Gupta, Ilavarasan, and Dwivedi [24] research design is a working plan, structure, and strategy of investigating so much conceived as to obtain answers to research questions and objectives.

The study adopts a qualitative research approach in generating enough evidence to achieve goals of the study, which sought to analyse the role of smart cities to promote smart governance.

According to McDonald and Headlam [19], the qualitative research paradigm "is concerned with quality of information, qualitative methods attempt to gain an understanding of underlying reasons and motivation for actions and establish how people interpret their experiences and the world around them." Therefore, since the study seeks to analyse the role of smart cities in promoting smart governance, it is best suited to the qualitative research paradigm.

3. Data collection techniques

The study used a qualitative desktop analysis of its literature as its data collection method. According to Mogalakwe [20], the use of documents, sources or literature study, secondary research and documentary analysis, the use of works from other scholars and official documents has always been reliable data gathering methods in social science.

The literature study focused on analysis of academic or scholarly articles and journals by various authors on the aspects of smart cities, service delivery, ICT, smart governance and IoT.

3.1   Search items

The following are the terms that informed this desktop analysis:
•   ICT;
•   Smart Cities;
•   Smart Governance;
•   Innovation;
•   Digital technologies;
•   Intelligent and adaptive solutions;
•   Open data;
•   Participatory citizenship;
•   Ethics and values;
•   E-governance.

4. Literature review

4.1   Theory of Open Innovation model

This paper is buttressed and supposed by the full life cycle co- evaluation of co-production in LLs. According to Shafie-khah et al. [25] the model covers the stages in decision, solution design and prototype for any IT concept. Paskaleva and Cooper [8] envisage that the model shows an innovation of a continues process of self-assessment that is occurring in parallel with core production of public services. According to the model, it emphasizes the central place of co-evaluation in the co-production of smart city service. It depicts lifecycle of the process from concept, on to decision, design, development using the service, with co-evaluation being interfaced throughout the whole process

The co-production concept is synonymous with the work of civil engineers and networks in integrating the ICT communication technologies such as 5G, Wi-Fi, telecommunication cables, roads, API, artificial intelligence software and various IT infrastructure.

4.2 Evaluation of the Open Innovation model

The model shows the principal place of connectivity using the concepts of co-evaluation in the co-production of smart cities. The theory is an epitome to policy analysis and implementation in the urban set up because it explains how administrators and city planners of smart city should incubate the concept of smart city, make decisions about the ICT infrastructure, design, and the development of the new ideas. If these stages of the open Innovation model are followed there are connectivity benefits, and the smart city concept are achieved. However, the theory is rather Eurocentric and caries a westernized modern city concept and does not explain well how the public policy is integrated. The type of the services to the provided in the smart city are not spelt out and its only leaves one to guess the public services that will be put in place.

4.3 Summary of the recent research papers, articles and journals in the Smart City concept

Year published	Author	Country	Title	Research Foci	Publisher	Nature of paper
2021	Kim, Sabri, & Kent	Australia	Smart Cities as a platform for technological and social innovation	Technological and Social innovation	Elsevier	Article
2020	Benbunan-Fich, Desouza, & Normann Anderson	Europe	IT enabled innovation in the public sector	ICT in public sector	EJSI	Journal
2020	Belli, Cirani, Davoli, Melegari, Mónton, & Picone	USA	IoT Enabled Smart Cities Sustainable cities and challenges	Internet of things	University of Parma	Article

2020	OECD report	Korea	Smart cities and Inclusive growth	Smart cities	OCED	Article
2020	Mora, Deakin, Aina, & Appio	UK	Smart city Development: ICT innovation for Urban Sustainability	Smart city development	Research gate	Journal
2018	Paskaleva & Cooper	UK	Open Innovation and Evaluation of internet enabled services in Smart cities	Innovation	The University of Manchester	Journal
2019	Voordijk & Dorrestijn	UK	Smart cities technologies and figures for technical mediation	Emerging technologies	Routledge	Article

Fig 2 Recent articles and Journals to the special issue

The paper by Kim, Sabri and Kent [6] is the most recent and updated paper which explains that smart cities are acting as technological and social innovation platforms for most urban cities. This is a conceptual paper which elucidates the Australian perspective in the IoT in smart cities and it highlights how these cities brings in productivity, sustainability and liveability. These three cornerstones are the key concepts that are discussed, and they are linked to the political, institutional and historical context of the concept of smart cities

Another paper is by Benbunan-Fich, Desouza and Normann Anderson [14] who explains the way how IT enables connectivity in the public sector. The paper gives a genesis of the of the concept of smart cities in detail and harnesses contemporary research in public sector explaining how IT innovations facilitate public sector development. However, the paper touches on technical and social impediments such as a lack of adoption by many public sector organizations with regards to emerging technologies of the fourth Industrial revolution which has caused the innovations to lay idle.

Another study is by Belli et al. [23] who explained the concepts related to our study of the IoT in the context of smart cities. They elaborate the ongoing diffusion of the IoT as a

catalyst which opens new possibilities for changing smart cities to be better than ever before. According to the authors, IoT and ICT technology can improve city management with the aim of addressing exponential population growths in most urban cities of the world. Furthermore, the rapid urbanization and massive population growths in most mega cities need connectivity so that the quality of people and businesses are improved [23]. Lastly, in the paper, the authors outline the characteristics of smart sustainable cities in that they share experiences, projects, strengthen the identity of the city and focus on the sharing of core values and social responsibility that improves the lives of the people and firms.

Voordijk and Dorrestijn [9] also explains that smart cities are a hub of technological mediation. In their article, the authors give a synopsis of the UK scenario, and they posit that smart city technology impacts positively on the citizens behaviour in the usage of ICT gadgets. Moreover, there is increase in human action by seeing reality of life and there is changing human perceptions and the philosophies of life are changed for most inhabitants of smart cities. The smart cities technologies are impacting positively on the city life and act as technical mediation. Furthermore, the authors seem to be viewing innovations of AI as replacing human beings in bringing another lifestyle brought by the smart city infrastructure. The AI is solving certain city problems and improves service delivery [9]. According to Mora et al. [10]:

"This global trend has been captured by the United Nations (2014) demographic change estimates, which show how the powerful attraction exhibited by urban areas has been progressively growing since 1950, leading to a mass relocation. As a result of this demographic transition, in 2007, the population living in urban areas outnumbered the rural areas' inhabitants."

From this assertation it can be postulated by the authors that smart city is a global trend that is taking the world by storm. The rapid urbanization has caused cities to develop in the digital or virtual cities that allows a high standard of interaction than ever before. The OECD Report [15] highlights some group of researchers of the member state group have conducted. The paper explains the countries that are already spearheading the projects and outlines the case study of Korea, Japan, Canada, and Italy. Of importance is the policy implementation and strategic planning that has been done by the administrators and town planners. In Korea, companies have been awarded 20 million US dollars for three years. The innovations and strategic planning of the Korean smart city concept is based on the development of compact urban development, ICT industrial ecosystem designing and implementing a dedicated smart city system that are compatible to every stakeholder. The good news of the Korean experience is that the uptake of the project by inhabitants was successful because most of the population (95% have smart and mobile phones) hence the adoption of the innovation is very high.

Another case study presented is the Japan scenario which take the concept of smart city from an environmental focus of calling them "sustainable smart cities." The city administrators and planners optimize the planning, development, management, and operations. Another interesting point to note is that Japan takes the smart city innovations from a cross-sectional and multi-dimensional perspective. Their strategy is all-inclusive

and holistic in nature by combining the public and private sector in a public-private sector collaboration. This model appears to have worked because Japan boasts hosting the 2020 Olympics games which were delayed and later played in mid of 2021. Japan's cities are state of the art and well-engineered [15].

The other country is Canada which as used a tender awarding to businesses and public sector companies to compete build their mega cities. According to the report, the success is evident, although the challenge of partnership of the stakeholders took some time. Lastly, the report explains of Italy case study. The Italian smart city concept was spearheaded in the 2014-2020 being funded by the EU. The innovations used in the cities promotes a complete renewal of urban services and foster urban inclusion for the disadvantaged.

Lastly, a recent study by Paskaleva and Cooper [8] elaborates the term open innovation in the public sector innovation spectrum. The paper summarizes a European project about 6 smart cities which investigates the technological innovation and social innovation which is being brought by emerging technologies. Moreover, the research brings out the concept of co-evaluating and co-producing, which is the goal of companies and people in smart cities – becoming a citizen with an internet centric urban life.

4.3   Evaluation of the literature

The paper by Kim et al. [6] is a conceptual framework which clearly elaborates the benefits of IoT in three dimensions of productivity, sustainability, and liveability. It gives a discussion of the key drivers needed for implementation of the internet enabled smart cities for the innovation. However, the paper lacks a critical evaluation on the cost of developing smart cities. Belli et al. [23] delves deeper in the IoT which is a concept of internet that enables the cities to be connected. It elucidates the emerging technologies that are used in the smart cities but lacks the implementation side of how exactly the smart city technology and innovation is done. Another point to note about the authors is that they write with a Eurocentric smart city concept. They lack a developing model and most smart cities are focused on developed countries mega cities. It lacks a universal model smart city concept which fits both developing and developed countries.

The paper by Paskaleva and Cooper [8] argues and discusses the concept of innovation in detail and makes a balanced assessment of internet enabled public services in smart cities. Unlike Kim et al. [6] that element is lacking in terms of the nature of services that has been integrated with ICT. Furthermore, the paper gives different theoretical models and constructs such as the theory of innovation and stakeholder management.

The study by OECD highlights the methodology and case studies of each country (Korea, Japan, Canada, Italy). The benefits of the smart city innovations implemented are outlined. Furthermore, the strategic goals of each country are outlined. The key issue that can be deduced from the report is that smart cities need a public-private collaboration. The smart city does not benefit the public sector (which is the focus of this paper) but there is need of a strategic planning and inclusion of all stakeholders for its success. Lastly, another issue noted in the case studies of the four countries presented is the cost of these innovations. They are expensive and most EU countries and western countries use donations. Otherwise,

the task is behemoth or mammoth task for emerging economies and developing countries, for instance in Africa is still lagging. Only in Rwanda is the epitome of this concept being under implementation because of its robust ICT infrastructure. [13]

Lastly, the study by Voordijk and Dorrestijn [9] is clearer on the types of technologies or innovations that are prevalent or expected in the smart city concept. They explain the concept of technical mediation concept is a keynote point of departure in the study. CT is seen as harnessing people and the public services and is perceived as a bridge that builds the between the different city stakeholders. From the researchers of point of view, the use of technology as a bridge is good to make the process of integration faster in a city. However, the use of technology alone causes a technocentric syndrome

5. Findings and conclusions

The researcher did a review of literature in a documentary analysis of seven papers. The research paper was to assess the recent innovations and internet enabled services in the public services in smart cities. The contributions of the paper to smart city concepts have been explained. The findings of the review of literature are that:
•   The concept of smart city is related to ICT infrastructure in most recent writings;
•   The key words of connectivity, integration and Internet of Things (IoT) are key words worthy in smart city innovation studies;
•   There is still a gap to what exactly what constitute a prototype smart city;
•   Smart cities improve service delivery and quality of lives;
•   The philosophy of life changes by making smart cities;
•   The consumption behaviour of the citizens and companies in ICT gadgets increases by constructing innovations of smart cities.

The benefits of the internet and innovative technologies are being needed to facilitate AI, IoT, ICT infrastructure so that connectivity makes life of inhabitants so easier. This built agility, connectivity and robust cities that have more informed citizens. The service delivery by the municipalities in enhanced and communication and reporting is made easier. However, most of the literature findings attest to the fact that the emerging technologies of smart cities are expensive and require huge capital injections from the governments concerned. That may require millions of dollars to design and finally implement. Lastly, another challenge of the concept of smart city innovations is that not all public administrators will adopt the concept.

6. Future research directions

In light of the findings from the reviewed literature, serious gaps have been identified and this paper has only covered a few as a result of its scope. Future research gaps include:
•   The alignment of the concept of smart city to strategic planning processes
•   Emerging technologies used in the development of smart cities;
•   The Internet of Things (IoT) concept as a central tenet of service delivery initiatives in the smart city of developing countries of Africa and the world;

- An evaluation into the role of model smart city in the public sector service delivery;
- Digital innovations and the development of Smart cities technologies;
- Strategies to manage smart city technologies by public service administrators.

7. Recommendations for Smart City Innovations

- From the OCED Report [15] of the literature review, the following recommendations are key takeaways that need to the considered about the innovations of smart cities:
- While the digital revolution is offering an unprecedented window of opportunity to improve the lives of millions of urban residents, there is no guarantee that the rapid diffusion of new technologies will automatically benefit citizens across the board. Smart city policies need to be designed, implemented and monitored as a tool to improve well-being for all people.
- Building smart cities is not only the business of cities or the private sector. National governments can and should play an enabling role to support innovative solution delivery, capacity building and upscaling.
- Measuring smart city performance is a complex task but is critically required. Advancing the measurement agenda calls for a comprehensive, multi-sectoral and flexible framework that is aligned with local and national strategic priorities and embraces efficiency, effectiveness, and sustainability dimensions.
- Smart cities need smart governance. Business and contractual models need to adapt to rapidly changing urban environments and encompass a more holistic approach, sometimes re-regulate rather than simply de-regulate, and leverage public procurement, including at the pre procurement stage.
- Citizens are not the only recipients but also active participants of smart city policies. Putting people at the centre of smart cities means co-constructing policies with citizens throughout the policy cycle.

8. Conclusion

Introduction of the smart city concept without the expected political will to reengineer the local sphere of government cannot be a silver bullet to the basket of challenges facing local governments but can be a panacea to a plethora of challenges related to service delivery, urbanization, digital transformation, and good governance. Migrating from traditional services delivery initiatives to the new technologically inclined strategies may pose a challenge and can confront resistance from administrators, however, major policy shifts and strategies towards the successful realization of the full implementation of the smart city concept can assist local governments in promoting mart governance to speed up service delivery and improve effectiveness, efficiency, and capability of local governments to deliver their core mandate.

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